THE

RAILWAY GAZETTE

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1 IN 10 CROSSOVER ROAD AT GAMSTON ON THE EAST COAST MAIN LINE OF THE EASTERN REGION, BRITISH RAILWAYS.

This crossover on the Up and Down Main Lines has welded joints throughout and is situated in a length of continuously welded track.
The photograph shows the layout which was manufactured by us from B.S.110A F.B. rail and had been built up on Jarrah Timbers at our works to the exact requirements of the Chief Civil Engineer for his inspection.

Photograph by courtesy of the Chief Civil Engineer, Eastern Region

We specialise in the manufacture of switches and crossings; single, double and outside slips; tandem, threethrow and simple turnouts; scissors crossovers and layouts of any description.

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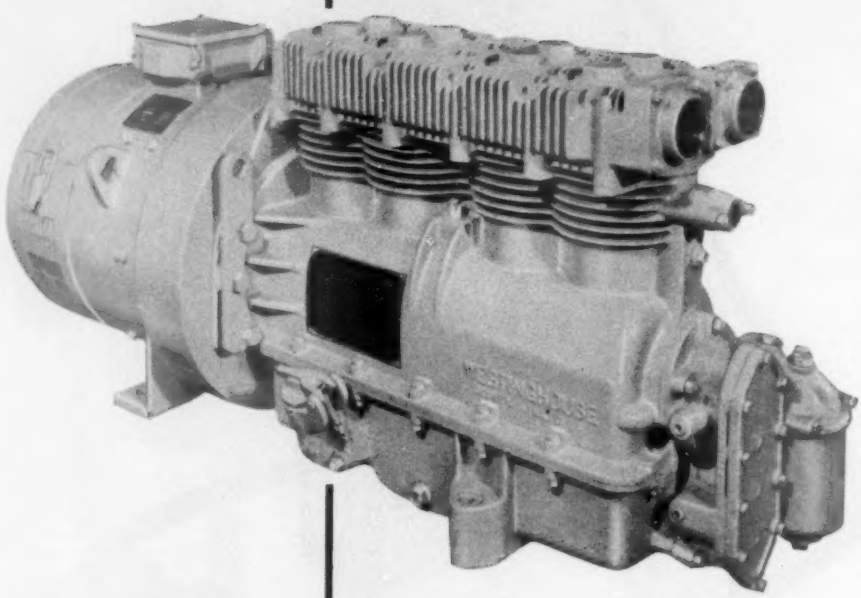

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'ON-TIME' ARRIVAL

Brush Type II locomotive with Mirrlees JVST engine draws into No. 6 Platform at King's Cross with the empty stock to form the 5.10 p.m. for Royston . . .

. . . The London Commuter knows when he's on to a good thing but as he sits back little thought is spared for the Mirrlees diesel which gets him in on-time. Now, in many parts of British Railways, Eastern Region the story is the same—punctuality and reliability—thanks to Mirrlees diesels.

Mirrlees **diesels** **provide the power**

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A*

One of the 750 h.p. Bo-Bo diesel-electric locomotives for the Jamaica Government Railways. Similar locomotives are in service in Ghana, Nigeria, New Zealand and South Africa.

MODERNISATION OF THE WORLD'S RAILWAYS...

'ENGLISH

in association with: VULCAN FOUNDRY

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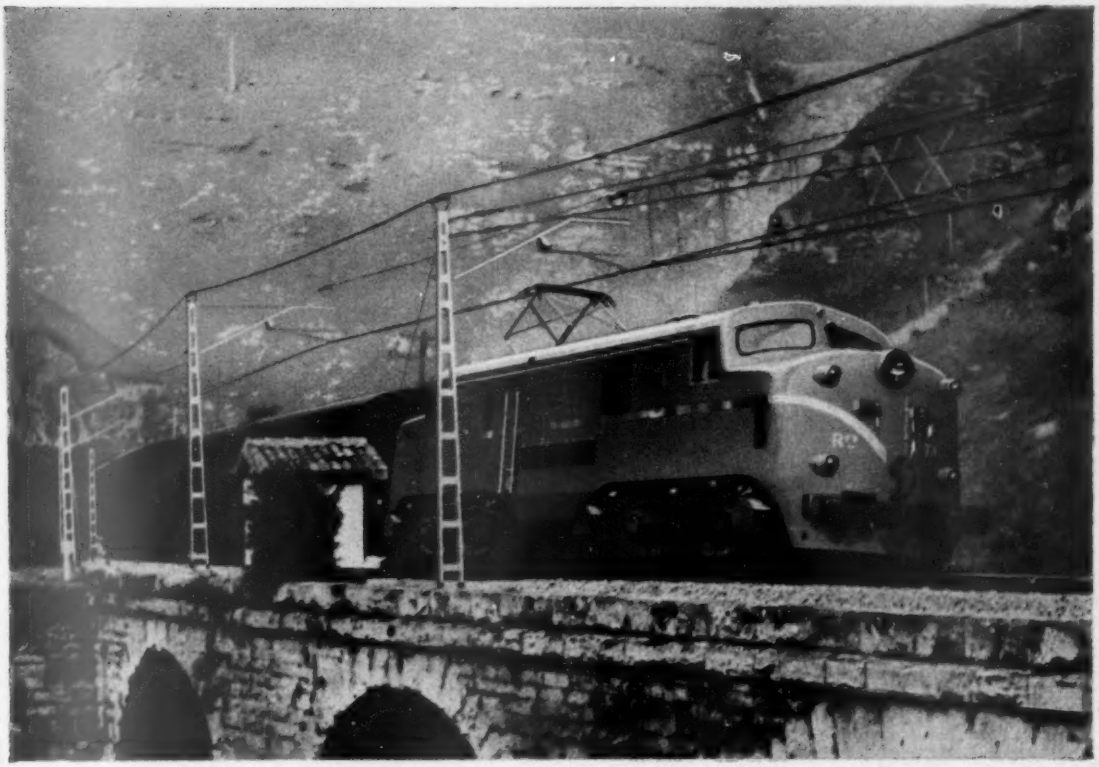

Seventy-five of these 3,600 h.p. 3,000 volt D.C. electric locomotives are in operation with the Spanish National Railways, hauling heavy mineral and passenger trains over mountainous routes in Northern Spain.

'ENGLISH ELECTRIC' diesel-electric and electric locomotives, built for regular trouble-free service under diverse operating and climatic conditions are helping to modernise railway systems in 30 countries throughout the world.

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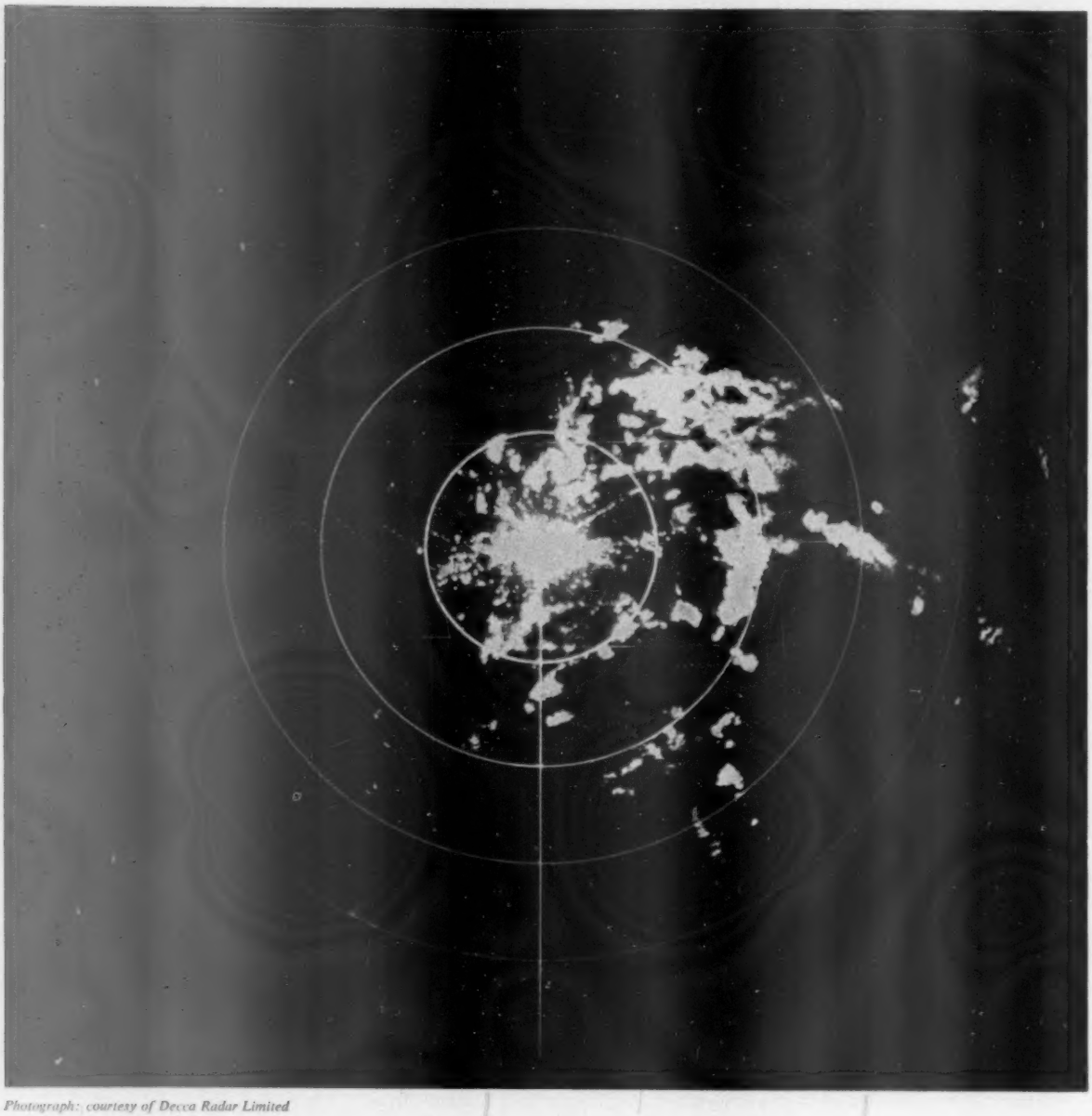
ROBERT STEPHENSON & HAWTHORNS



Photograph: courtesy of Decca Radar Limited

Storm centres known as "thunderheads" are detectable from many miles away by radar. Pilots are able to make a detour for the safety of their aircraft and passengers. DOCKERS' PAINTS have given sound protection to rolling stock, vehicles and buildings on the transport systems of the world in all weathers for more than 70 years. DOCKERS are also pioneers in the development and production of the very specialised finishes for aircraft.

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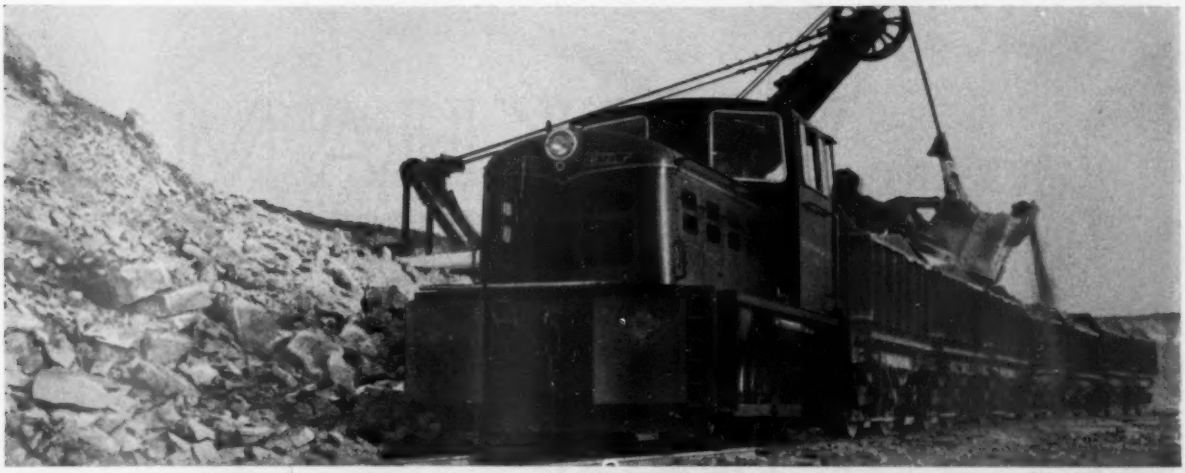

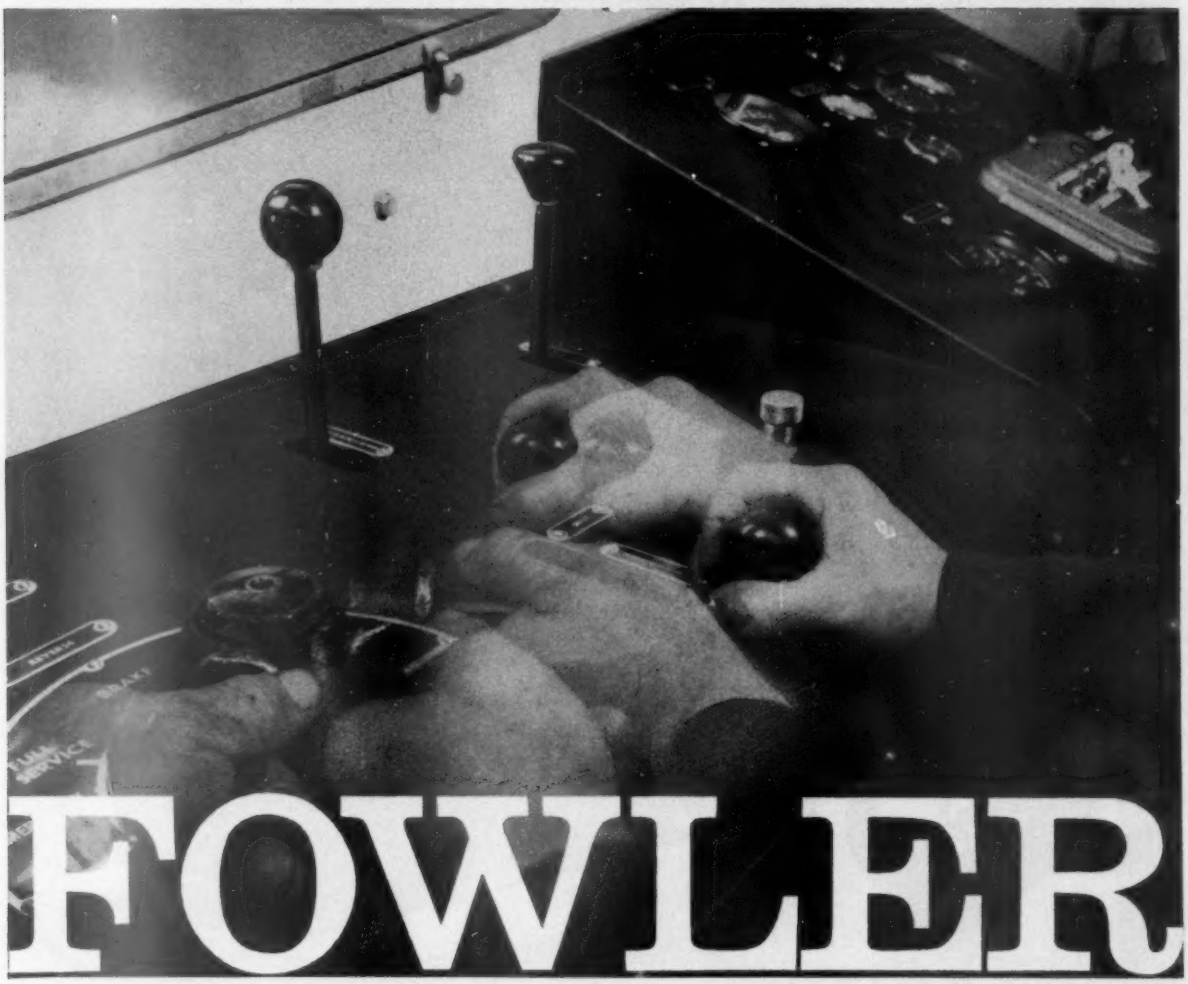

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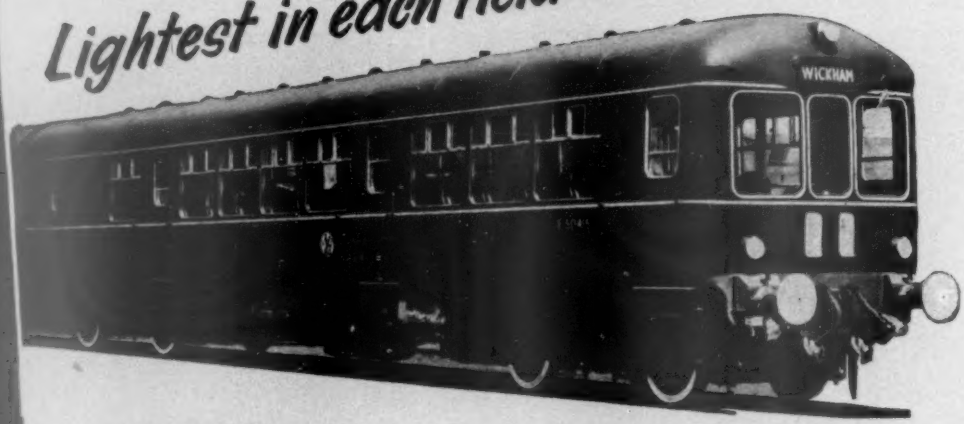

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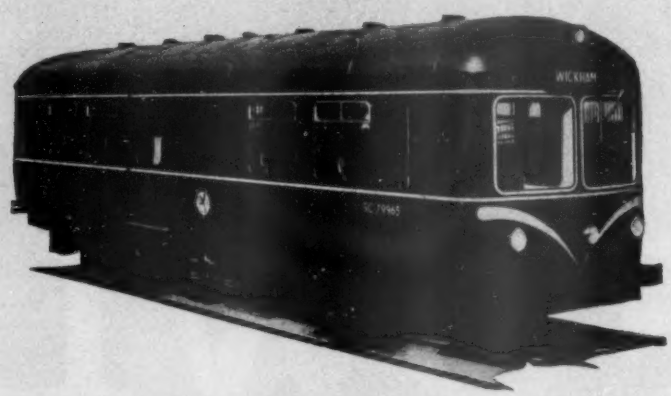
stressed body construction as used in these cars provides the lightest and strongest type of coach. The Wickham method of tubular construction has now given over twenty years, successful service under exceptionally severe conditions in many parts of the world.



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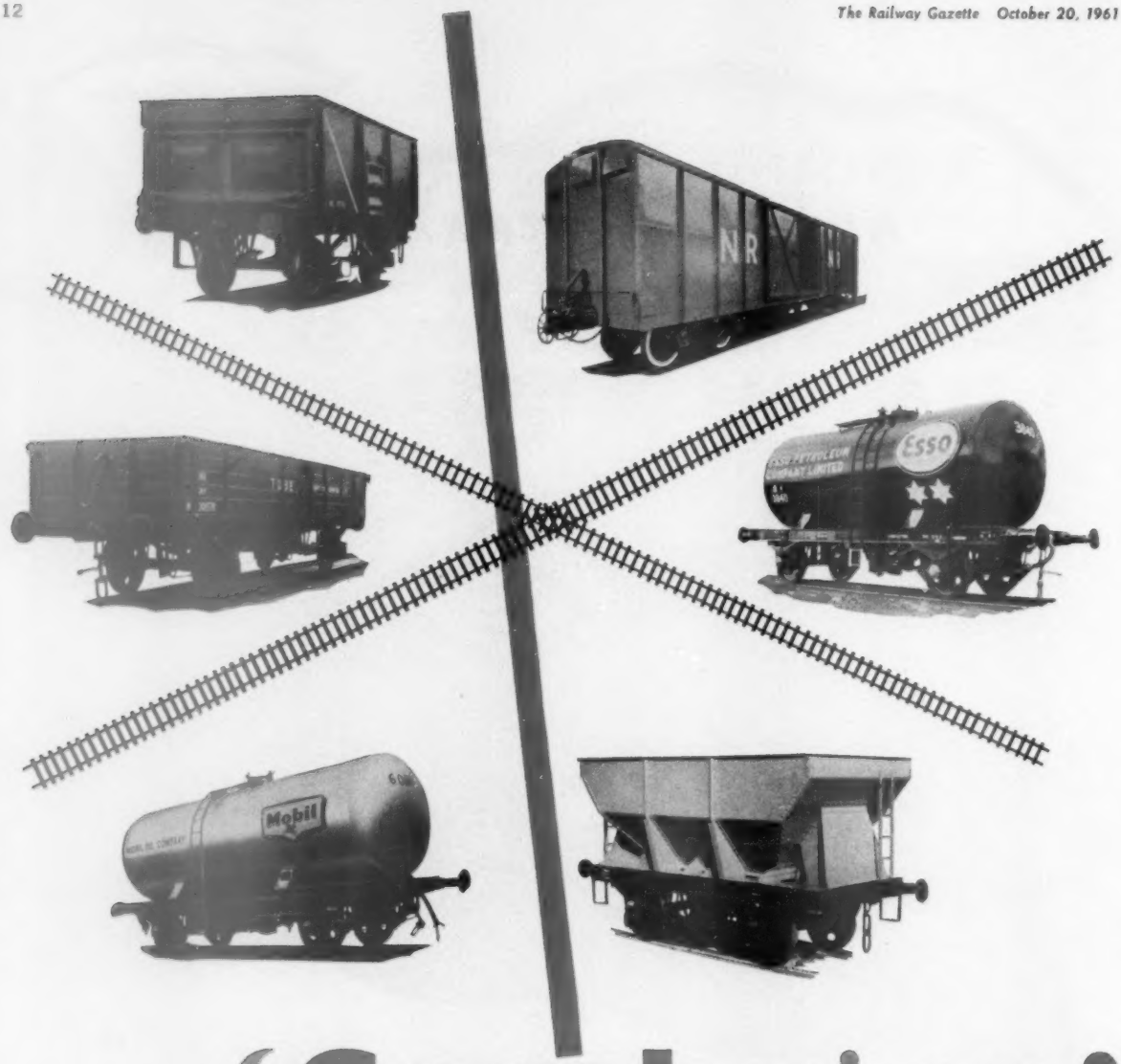

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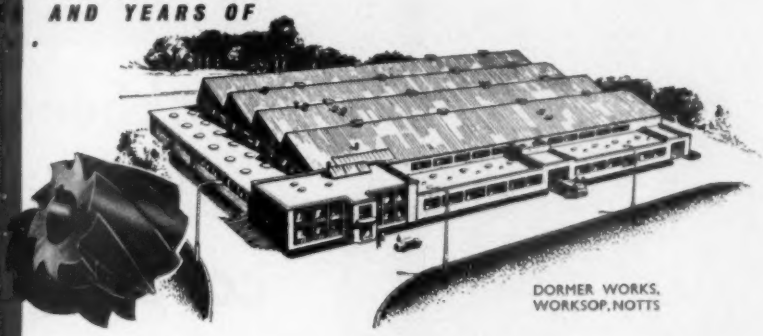

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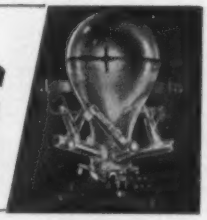
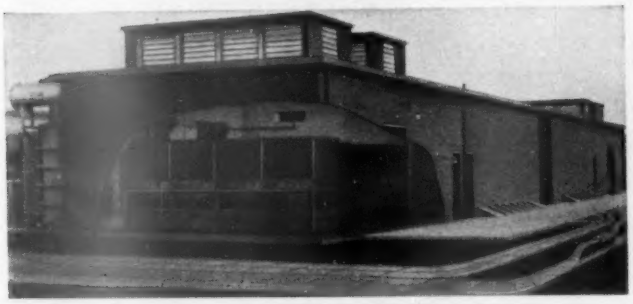


the converting plant used by the World's principal railways

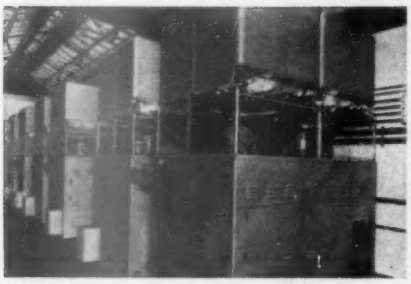


BRITISH RAILWAYS SOUTHERN REGION

One of 28 substations equipped with Hewittic Rectifiers by the British Transport Commission for the Southern Region of British Railways. The photograph shows Wimbledon sub-station with one wall cut away to show the two 2,500 kW rectifiers in this half of the building.

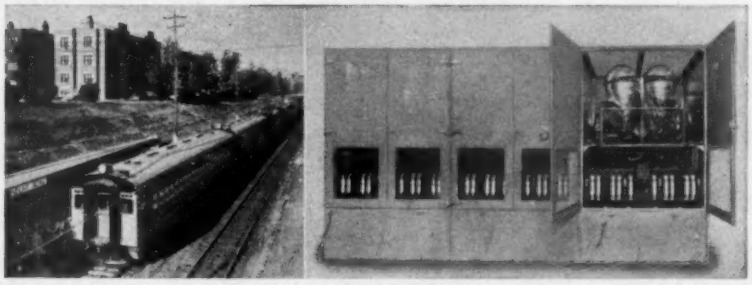
BRITISH RAILWAYS
LONDON MIDLAND REGION

A train passing one of the 14 Hewittic Rectifier substations on the Liverpool-Southport line. These have an aggregate capacity of 24,260 kW and supply 93 miles of electrified track. Hewittic Rectifiers installed on other sections of this region total 47,300 kW



LONDON TRANSPORT RAILWAYS

The 4,000 kW Bond Street substation, equipped exclusively with Hewittic Rectifiers. The plant comprises four 1,000 kW combined rectifier and enclosed air-cooled transformer units. This company is also responsible for the supply and installation of all A.C. and D.C. control gear. Some 90,000 kW of Hewittic Rectifiers have been supplied to the London Transport Executive.



CANADIAN NATIONAL RAILWAYS

The electrified section of the Canadian National Railways, comprising some 70 track miles in the vicinity of Montreal Terminal, is supplied with D.C. by Hewittic Rectifiers in two 3,000 kW substations at Central Station and Saraguay. The photographs show left, a train leaving Mount Royal Station, and right, one of the four 1,500 kW equipments in service. These are designed for operation at 3,000 volts, D.C.

* Send for Publication R200/4

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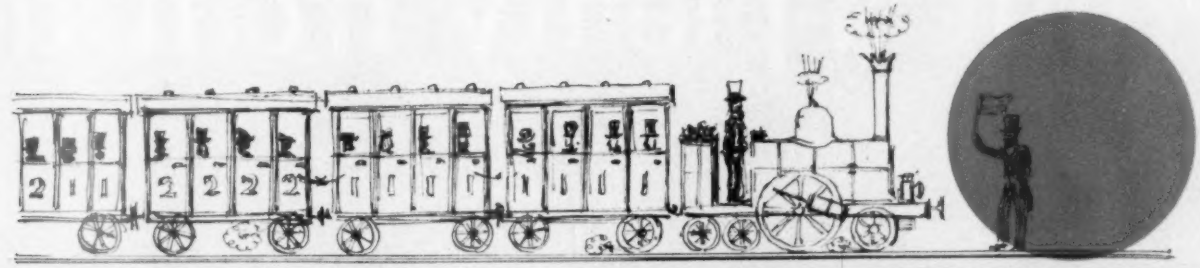

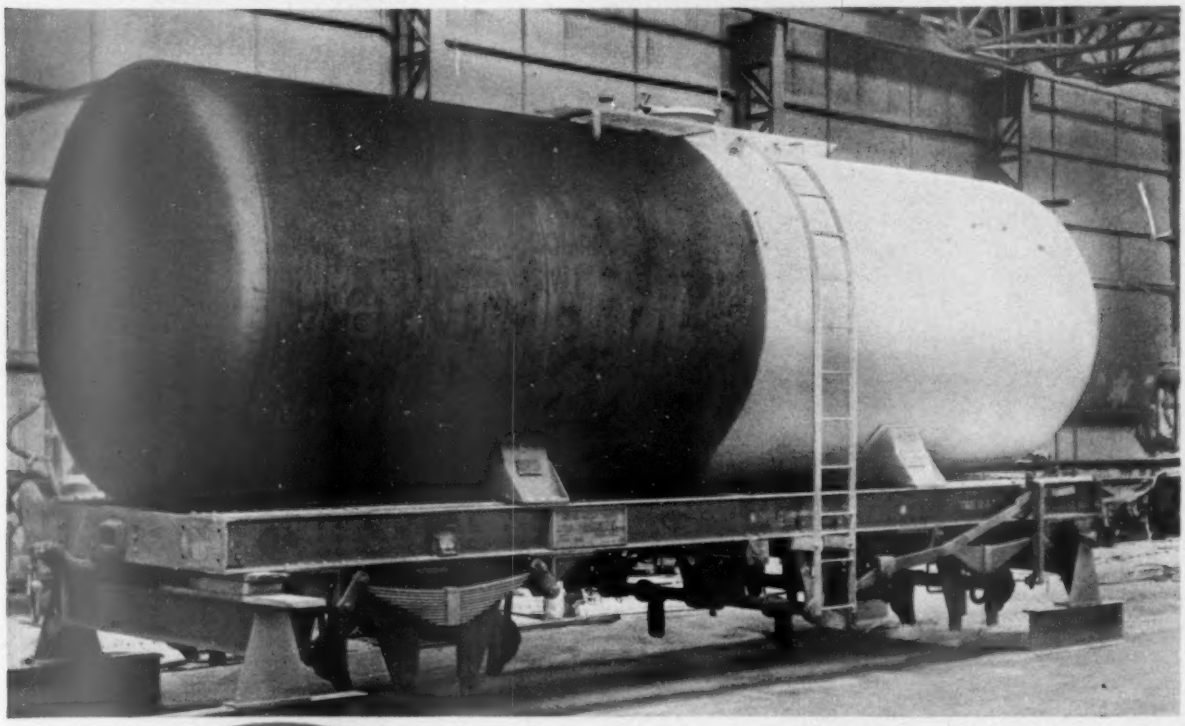

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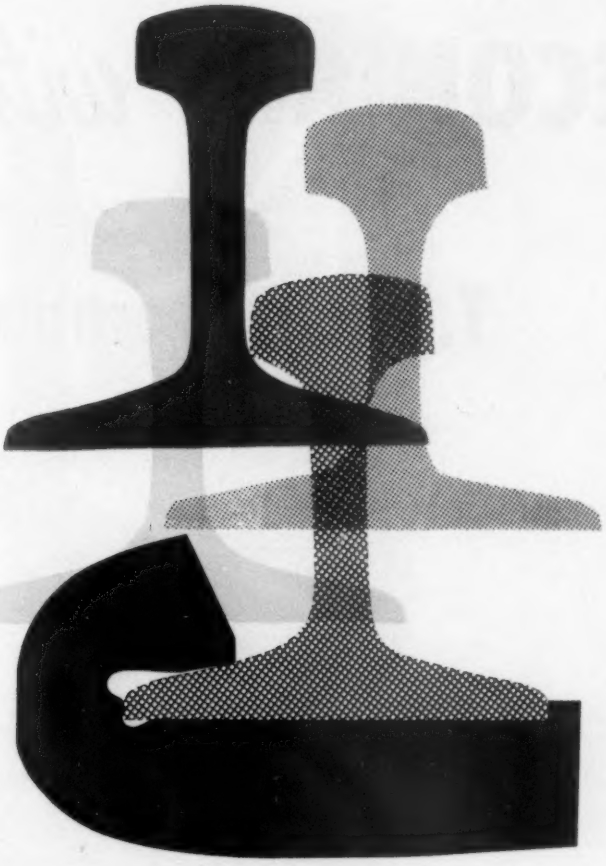

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—and **SAFETY** assured by 25 years of experience backed by constant research and improvement

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In Pel's view, only the closest examination of the very bones of a seating problem can yield a correct and logical design.
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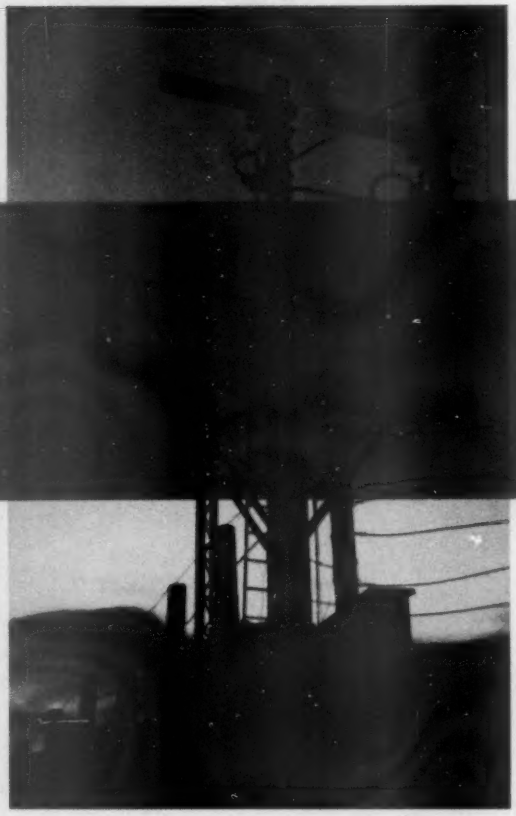
STEEL AND THE RAILWAYS



The lifeline of the nation . . . vital to its economy . . . vital to its progress . . . vital in fact to its very existence . . . is the railway network. The key factor in its continued development and operation is steel. Here the Colvilles range of special steels has been developed to meet the needs of the nation today.

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Coaches for
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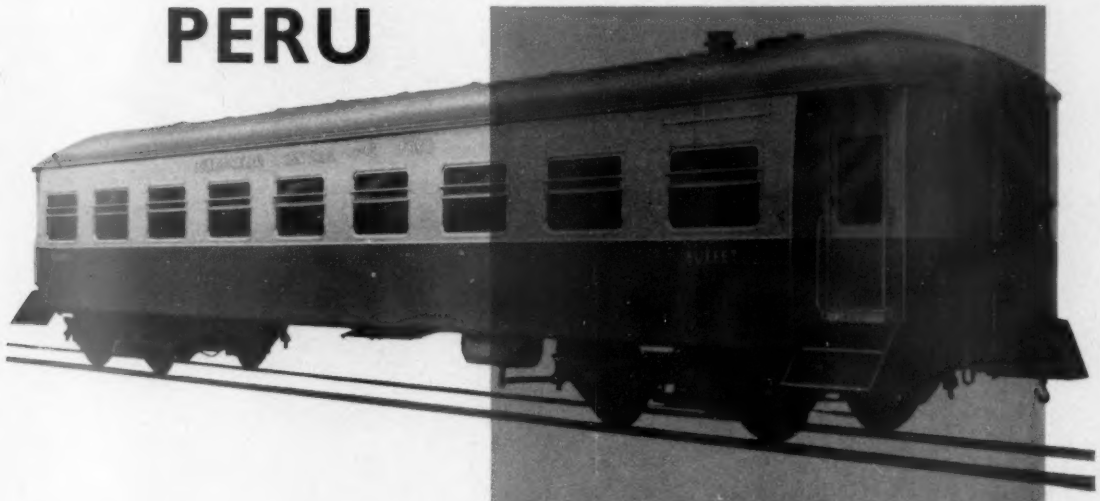
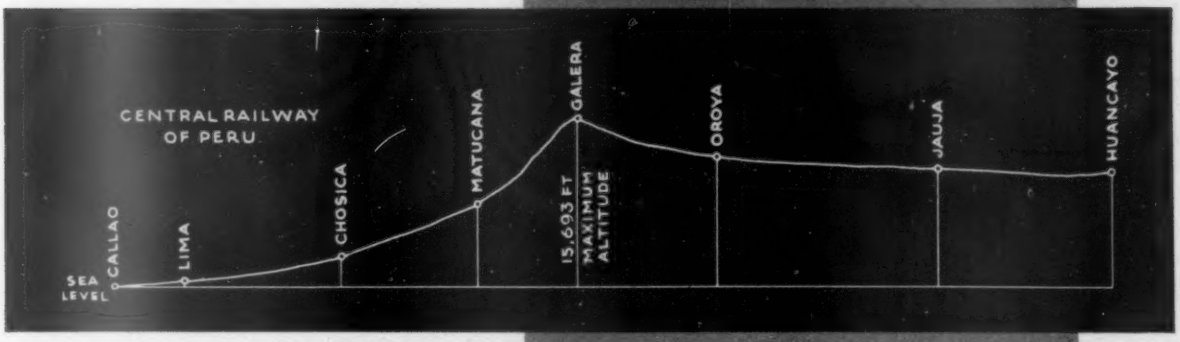


Recently delivered for service on the Central and Southern Railways of Peru are a number of special lightweight steel coaches of various types with tare weights of 18¼ tons. Illustrated is a 1st class kitchen buffet car with seating accommodation for 26 passengers.



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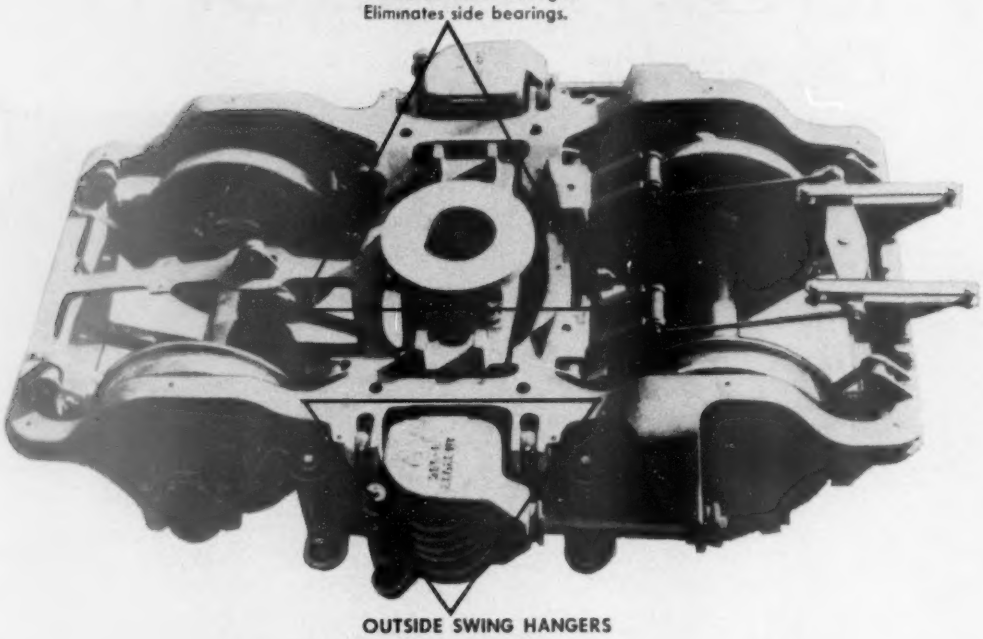
Eliminates bogie shimmy.
Increases wheel mileage.
Eliminates side bearings.



OUTSIDE SWING HANGERS
Inspection and maintenance are quick and easy.
Broader spring base contributes to better riding.

YOU CAN SEE THE DIFFERENCE IN COMMONWEALTH PASSENGER BOGIES

The large central bearing in Commonwealth passenger coach bogies eliminates side bearings and bogie shimmy, and also increases wheel mileage.

The outside swing hangers provide a broader spring base which contributes to a smoother passenger ride, and they are located so that inspection and maintenance are quick and easy.

These are two of the superior features which have made Commonwealth cast steel bogies known and used around the world on local and inter-city transit systems and railways. A wide variety of designs is available to fit your need, each design based on General Steel's more than 50 years of experience in designing, making and service-testing passenger bogies.

Commonwealth products are furnished completely machined and are designed for all track gauges by

GENERAL STEEL INDUSTRIES, INC.

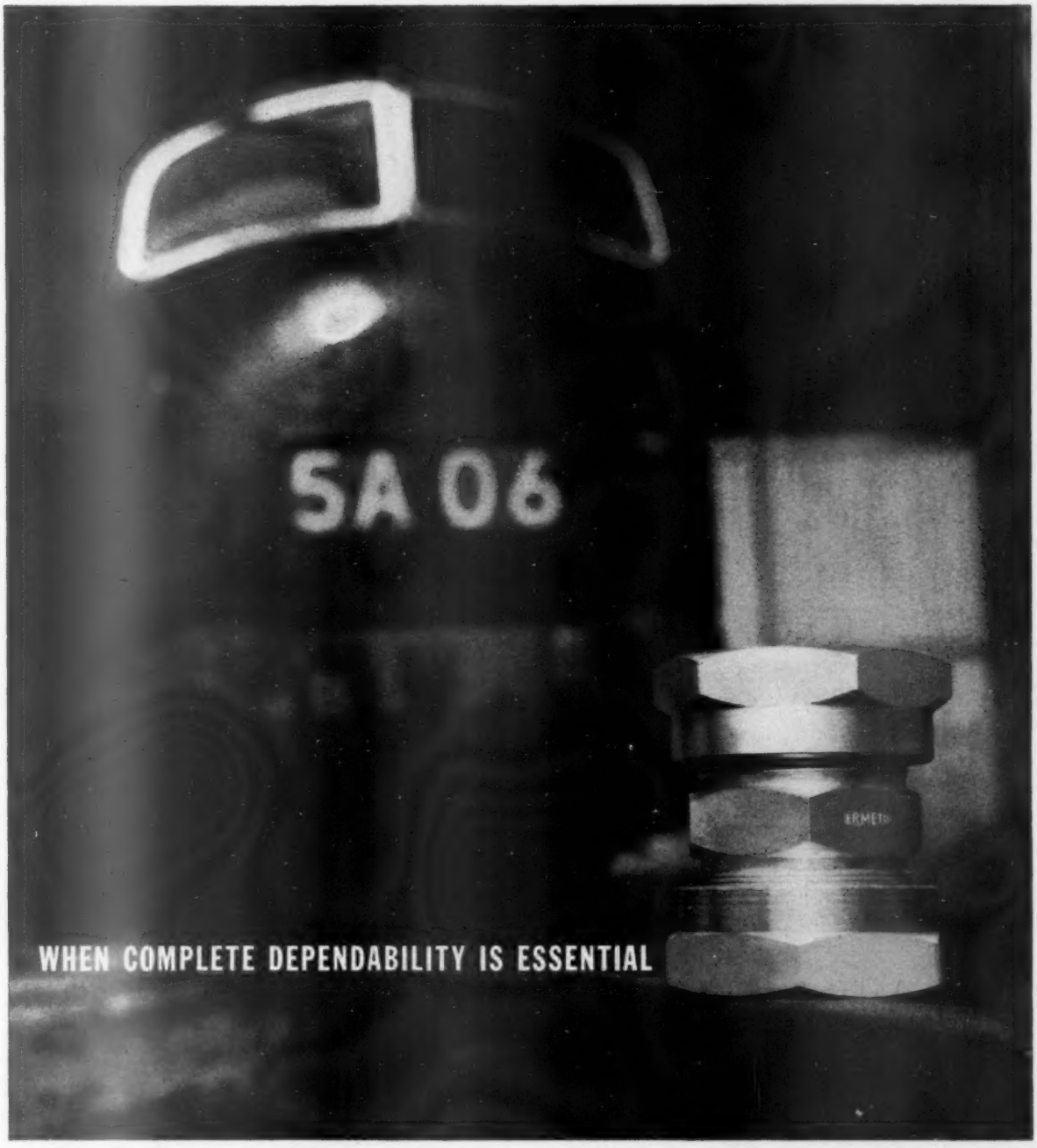
Granite City, Ill. • Eddystone, Pa. • Avonmore, Pa., U.S.A.

Subsidiary: St. Louis Car Company, St. Louis, Mo.

Commonwealth Products are produced under license in Australia, Canada, England and South Africa

COMMONWEALTH SALES CORPORATION

International Representatives: Granite City, Illinois, U. S. A., *Telegraph:* "Comsteelco"



On powerful, heavy diesel locomotives, the couplings for brakes and other services must always be pressure tight. Once again the specification calls for Ermeto... Ermeto who provide the largest standard range of high-pressure pipe fittings in the world, in addition to valves and flexible hose assemblies. Also many non-standard fittings are produced to meet our customers' requirements. Our Technical Advisory Staff are at your service and a copy of the latest edition of the Ermeto catalogue, which is a standard reference for piping layouts, will gladly be sent to you on request. HIGH PRESSURE PIPE COUPLINGS: VALVES: FLEXIBLE HOSE AND END FITTINGS: STEEL AND COPPER TUBE.

BRITISH ERMETO CORPORATION LTD
HARGRAVE RD · MAIDENHEAD · BERKS · TELEPHONE: MAIDENHEAD 5100
A MEMBER OF THE ALENCO GROUP OF COMPANIES

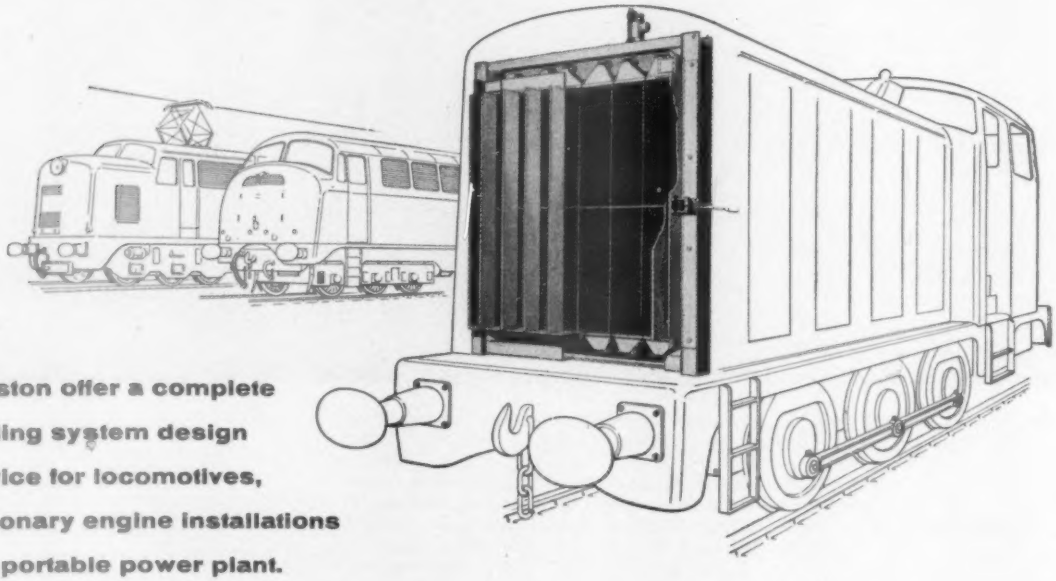
ERMETO

C

For all locomotives— Marston element-type radiators

Long experience of heat-transfer problems, advanced techniques and a comprehensive design service make Marston element-type radiators the best of their kind for locomotive service. By combining several elements, one of these robust, efficient cooling units will deal with heat from several sources—for example, engine coolant, lubricating oil and transmission fluid.

* Interchangeable elements simplify servicing.
* Choice of light-alloy or copper/brass elements.
* Resistant to impact loads, vibration and thermal shock.
* Built to withstand high internal pressures.

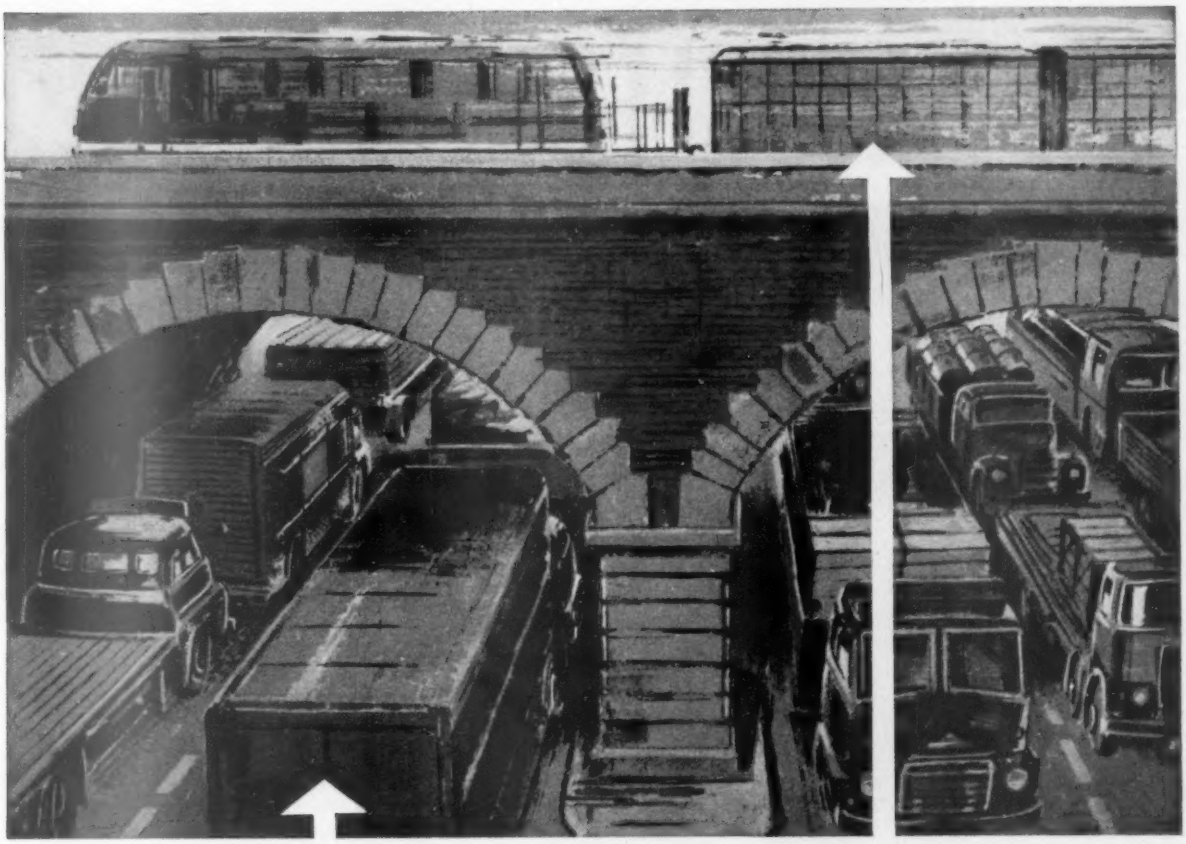


Marston offer a complete cooling system design service for locomotives, stationary engine installations and portable power plant.

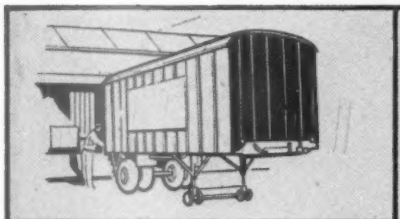
MARSTON EXCELSIOR LTD. **WOLVERHAMPTON AND LEEDS**

(A subsidiary of Imperial Chemical Industries Ltd.)

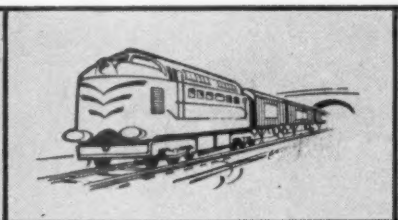
MAR.278



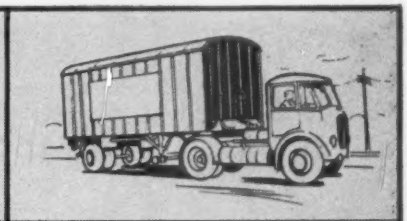
This lorry... could be up there if only it were a Roadrailer!



1 The Roadrailer, loaded at the factory as an ordinary articulated lorry.



2 The Roadrailer as part of a fast freight train.



3 The Roadrailer converted back to a lorry completes delivery by road.

What have roads got that railways haven't? Door-to-door service on the same vehicle. They also have something else—traffic jams! These can make a potentially fast service into a frustratingly slow one.

The railway's fundamental equipment is the permanent way and on direct hauls it is the cheapest form of overland transport. To neglect its clear-cut advantages on long and medium trunk hauls does not make sense.

Now the Roadrailer gives the obvious answer. It is a road vehicle that is transferred on to the permanent way in 150 seconds by letting down rail wheels. It can be adapted for any traffic including liquids, timber, cement. It coddles its loads with a suspension so smooth that a threepenny bit has been made to stand on edge at 65 m.p.h.

Feed railheads by road; trunk between railheads by rail. That makes sense. And now the Roadrailer can achieve it as a practical, profitable proposition.

150 SECONDS — YOU CAN HAVE THE BEST OF BOTH WORLDS

PS

PRESSED STEEL CO. LTD.

Railway Division,
Linwood Factory, Paisley, Scotland

LONDON OFFICE: Railway Division, 47 Victoria St., London, S.W.1. HEAD OFFICE: Cowley, Oxford. BRUSSELS OFFICE: 2301/2307 Centre International Rogier, Passage International 6, Brussels 1, Belgium. Manufacturers of car bodies, Prestcold refrigeration equipment, all kinds of pressings and executive aircraft.

METCALFE'S

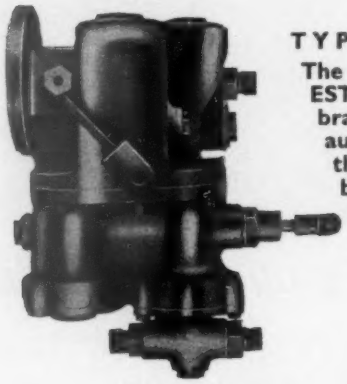
AIR BRAKE EQUIPMENT for

Carriages and Wagons

OERLIKON PATENT DESIGN

TYPE EST3d.

This standard and basic design of Triple Valve enables the controlled application and release of brakes on goods and passenger trains. It is suitable for all sizes of brake cylinder and is in accordance with the conditions laid down for the admission of goods and passenger trains for international traffic. Leaflet A.9.

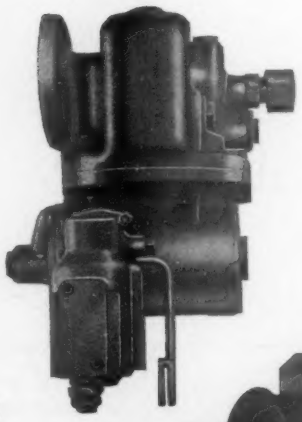


TYPE EST4d/AL.

The AL device used in conjunction with the EST Triple Valve, as illustrated, enables the brake cylinder pressure to be regulated automatically in proportion to the load on the vehicle, thus enabling the maximum brake efficiency to be obtained under all conditions. Among the advantages associated with this equipment are the simplicity of installation, further, the brake cylinder filling and releasing times are unaffected by load changes. Leaflet A.8

TYPE EST4d/R
TRIPLE VALVE

In this instance the type R device has been added to the EST Triple Valve to enable two-stage braking to be obtained. This arrangement when applied to high speed passenger coaches and controlled by the vehicle speed enables the maximum brake efficiency to be obtained and greatly reduces the distance required for stopping a train. This style may also be used for simple load and empty braking with the two stages Hand controlled. Leaflet A.5.



TYPE SB BRAKE CYLINDER
(Made under licence from STABEG)

A simple lightweight design of Brake Cylinder embodying a patent piston seal giving automatic lubrication to the cylinder walls and exceptionally long life to the seal. A further patent covers a security device which simplifies maintenance and examination of the Cylinder which is made in all standard sizes and styles. Leaflet A.14.

DAVIES & METCALFE LTD.
INJECTOR WORKS · ROMILEY · ENGLAND

Telephone: Woodley 2626 (2 lines) Telegrams: EXHAUST, ROMILEY

R.G.7

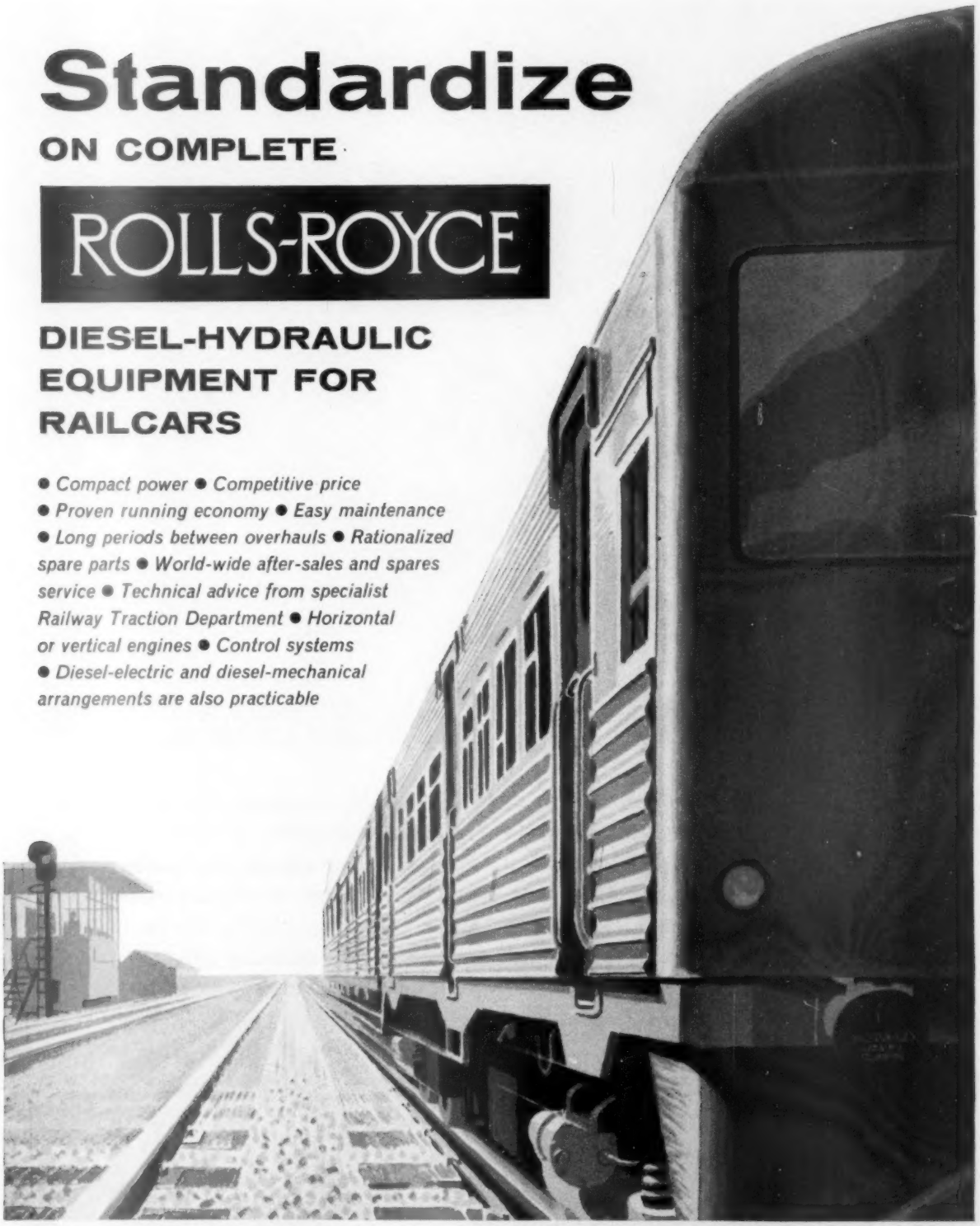
Standardize

ON COMPLETE

ROLLS-ROYCE

DIESEL-HYDRAULIC EQUIPMENT FOR RAILCARS

- *Compact power*
- *Competitive price*
- *Proven running economy*
- *Easy maintenance*
- *Long periods between overhauls*
- *Rationalized spare parts*
- *World-wide after-sales and spares service*
- *Technical advice from specialist Railway Traction Department*
- *Horizontal or vertical engines*
- *Control systems*
- *Diesel-electric and diesel-mechanical arrangements are also practicable*



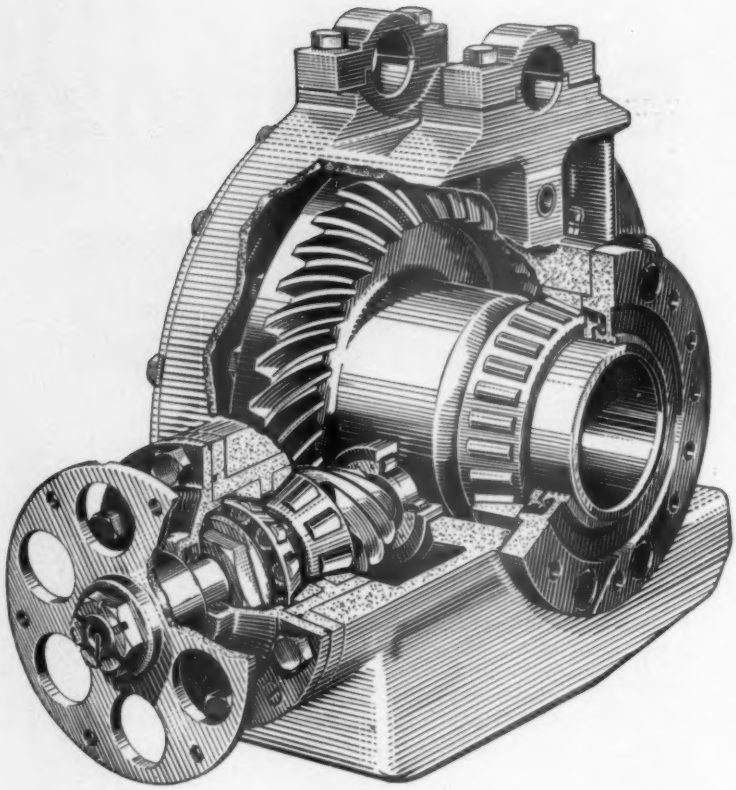
Builders of railcars and locomotives, and operators who are considering redesigning and re-engining existing equipment, are invited to write to:-

ROLLS-ROYCE LIMITED · RAILWAY TRACTION DEPARTMENT · SHREWSBURY (Tel: 52262) ENGLAND

ROLLS-ROYCE—AERO ENGINES · MOTOR CARS · DIESEL AND PETROL ENGINES · ROCKET MOTORS · NUCLEAR PROPULSION

ENV

FOR SPIRAL BEVEL AND HYPOID GEARS AND AXLE DRIVES



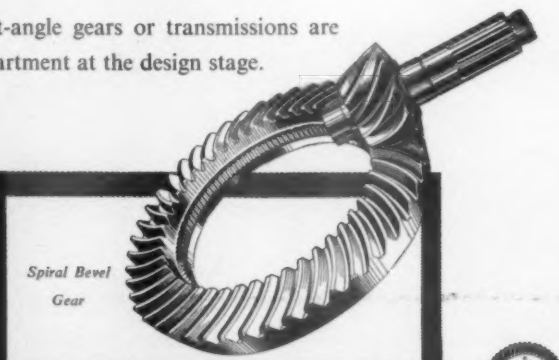
The right-angle drive, which now has so many applications for diesel and electric traction, is a job for the specialist.

ENV pioneered the spiral bevel and hypoid drives in this country and have over 30 years' experience in the design and manufacture of heavy duty right-angle drives.

Production facilities include the most modern gear cutting and heat treatment plants, enabling precision spiral bevel and hypoid gears to be supplied with profile ground teeth when required for high speed applications.

Traction engineers and designers who need right-angle gears or transmissions are invited to communicate with ENV Technical Department at the design stage.

ENV FOR GEARS



Spiral Bevel Gear

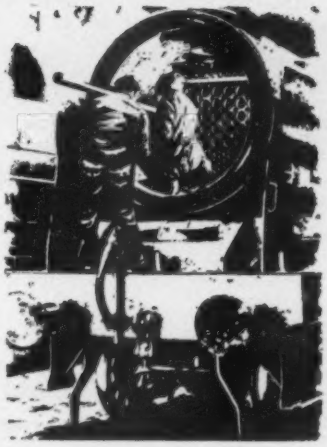
E.N.V. ENGINEERING COMPANY LIMITED, HYTHE ROAD, WILLESDEN, LONDON, N.W.10. Telephone: LADbroke 3622

AP 113

'ALFLOC' ON THE FOOTPLATE

Like most of us, the 'Alfloc' man probably once wanted to be an engine-driver. And, though his one-time ambition may have eluded him, he plays a vital part in helping the engine-driver. For 30 years, the 'Alfloc' Water Treatment Service of Imperial Chemical Industries Ltd. has been building up an unparalleled volume of skill and experience in handling problems of railway water treatment. Today, the 'Alfloc' man is helping to keep engines—both steam and diesel—out of the time-consuming sheds, helping to avoid exasperating breakdowns, helping to eliminate all problems connected with water usage.

Maybe the 'Alfloc' man can't drive the engine—but he brings the scientific and technological resources of I.C.I. to bear on all water problems that arise in keeping the engines running.



'alfloc' ICI

IMPERIAL CHEMICAL INDUSTRIES LIMITED
'ALFLOC' WATER TREATMENT SERVICE,
4 CROMWELL PLACE, LONDON, S.W.7.

AL.42

THIS TRAIN IS GOING PLACES

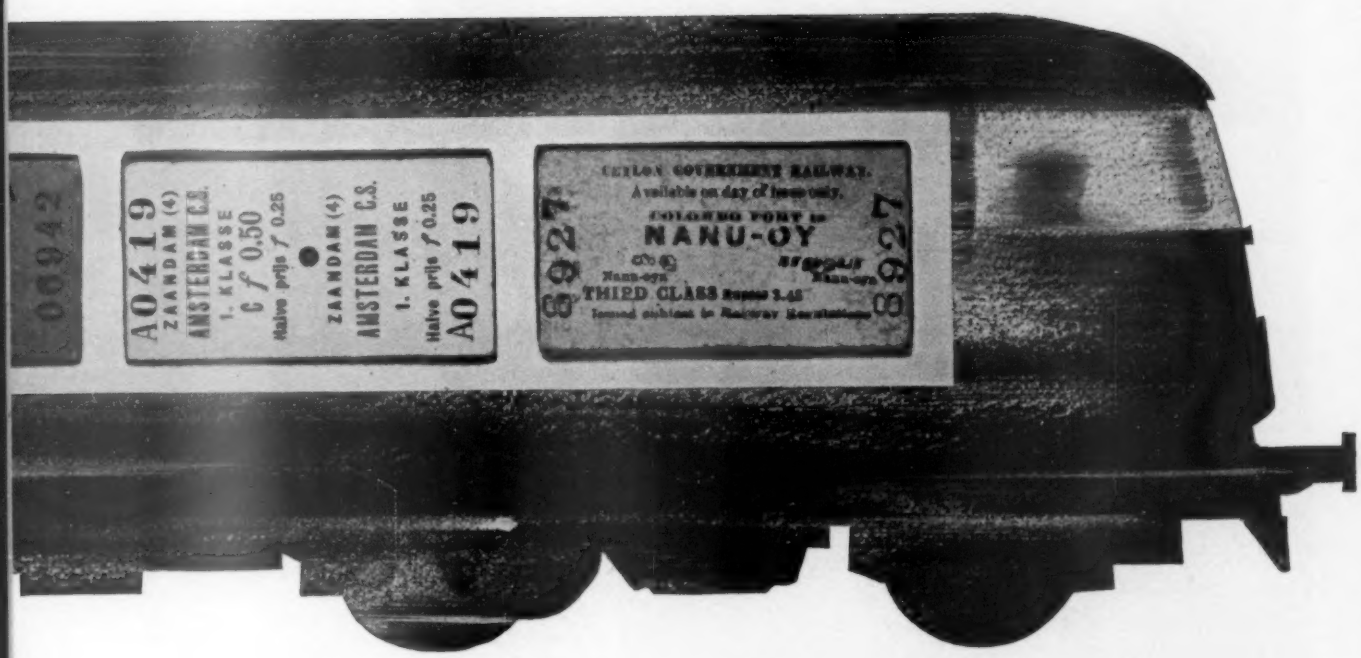
Johannesburg . . . Bombay . . . Lisbon . . .
Sarandi . . . Amsterdam . . . Nanu-Oya . . .
It could be any of these and more,
for G.E.C. can supply traction
equipment to *any part of the world.*

Complete electrification
Locomotives and trains—electric and diesel-electric
Cables, track structures and overhead lines
Power stations and sub-stations
Signalling and communications
Remote supervisory control
Lighting and heating
Kitchen car equipment

RELY ON THE

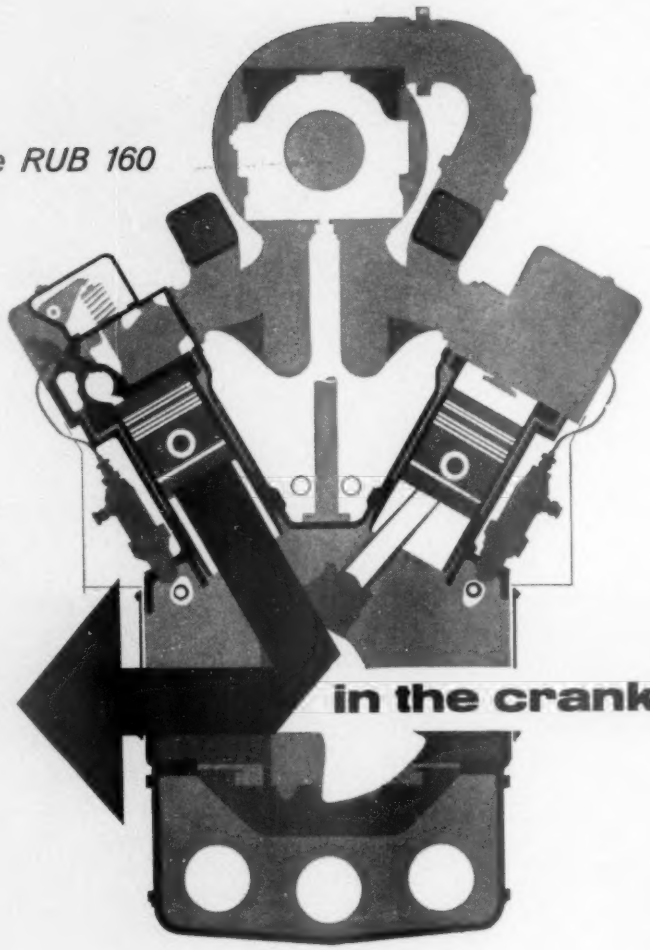
THE GENERAL ELECTRIC COMPANY LIMITED OF ENGLAND
TRACTION DIVISION BIRMINGHAM 6

377



EXPERIENCE OF G.E.C.

Werkspoor engines type RUB 160



Pistons

removable

via openings **in the crankcase**

considerable saving in time!

The pistons of the Werkspoor engines type RUB 160 can be removed sideways, through the openings in the crankcase, thus saving time: the cylinder heads and the associated pipeline connections need not be disturbed. The injection equipment and the valve-operating gear are located on the outside of the engine and are easily accessible. *Werkspoor RUB engines are characterized by low maintenance costs.*

Werkspoor RUB engines are four-stroke, high-speed V-engines, available with capacities ranging from 320 to 3,000 h.p. at 900 to 1,500 r.p.m. Bores 160 and 215 mm.

WERKSPOOR

AMSTERDAM WORKS (HOLLAND)

At London Airport, BEA Apron Control have reorganised their communication facilities to cater for their 400 air movements a day peak load. The controllers use STC Lightweight transmitter/receiver headsets to assist them with strain-free operation.

WIDER USE FOR STC lightweight headsets

R.M.S. Windsor Castle Radio Officer wearing STC lightweight headset.

Designed primarily for use by private and public telephone operators and approved by the British Post Office, STC Lightweight Headsets are now being widely used for other applications. Authorities and operators concerned with audio monitoring and control have quickly recognized the advantages in comfort and sensitivity provided by this new design.

The "Rocking Armature" principle which gives improved sensitivity and frequency response—an important STC development in telephone receiver design—has been incorporated into these instruments.

The main advantages of this STC product are: extraordinary light weight, a high degree of comfort, stability and manoeuvrability and constant level of transmission regardless of head movement. Available in black or ivory nylon plastic which is virtually unbreakable.

STC Lightweight Head Receiver in use at Broadcasting House. These instruments have been adopted by the B.B.C. for use in their London and provincial studios.

SWITCHING SYSTEMS GROUP

61/1D

Standard Telephones and Cables Limited

TELEPHONE DIVISION: OAKLEIGH ROAD · NEW SOUTHGATE · LONDON N.11

GET INTO THE JOB WITH A TAYLOR JUMBO

Excelling under low headroom conditions, completely self-contained, Taylor Jumbo cranes—each a powerful, low cost combination of diesel economy and hydraulic simplicity—are ideally suited to all railway goods handling operations. Speeding truck and wagon turnround . . . serving all parts of the goods yard . . . moving materials of every kind with safety and despatch.

Such is their versatility, Taylor Jumbo cranes are kept constantly on the move—perpetually fostering the economies which today's railways demand.

TAYLOR

Mobile Cranes

F. TAYLOR & SONS (MANCHESTER) LIMITED.

STEEL HOUSE, EASTCOTE, MIDDLESEX.
SALES AND SERVICE: LONDON, BRISTOL, BIRMINGHAM, MANCHESTER, LEEDS, NEWCASTLE, GLASGOW.

A MEMBER OF THE STEEL GROUP OF CRANE AND EXCAVATOR MANUFACTURERS

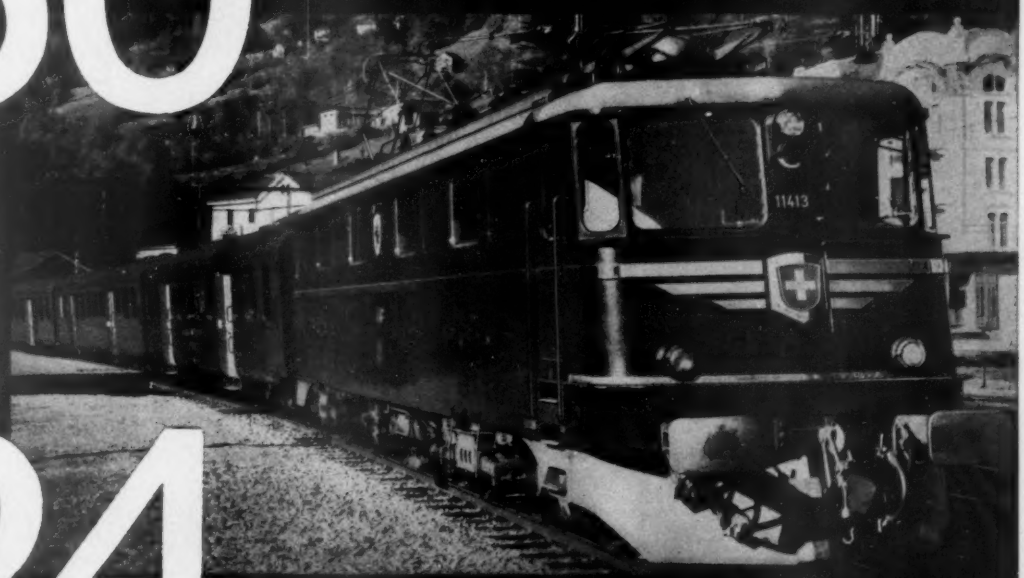
1014

SLM

90 years experience in design and manufacture of locomotives and railcars!

50

of these 6000 HP Co-Co type locomotives are giving excellent service on the Gothard and the Simplon lines of the Swiss Federal Railways.

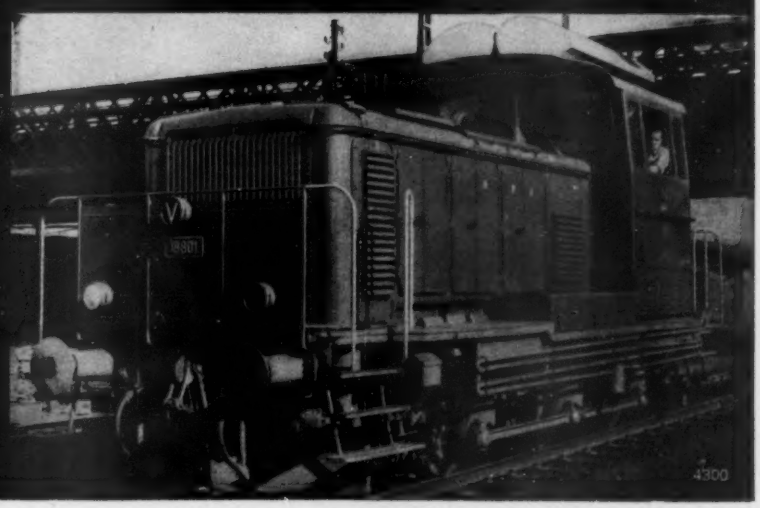


24

To meet traction requirements due to increasing traffic 24 more of these powerful and reliable engines have been ordered lately.

35

A further contract for the supply of 35 Diesel-electric locomotives, 600 HP each, fitted with SLM traction Diesel engines has also been placed by the Swiss Federal Railways.



Swiss
Locomotive and Machine Works
Winterthur

Insulation on the move?

Think Rocksil—want it resilient, flexible, light and inexpensive?
Think Rocksil. **More and more of today's insulated**
road and rail vehicles are being fitted with Rocksil insulation.
We have full technical data ready for you. Just ask us.

Rocksil

ROCK WOOL INSULATION

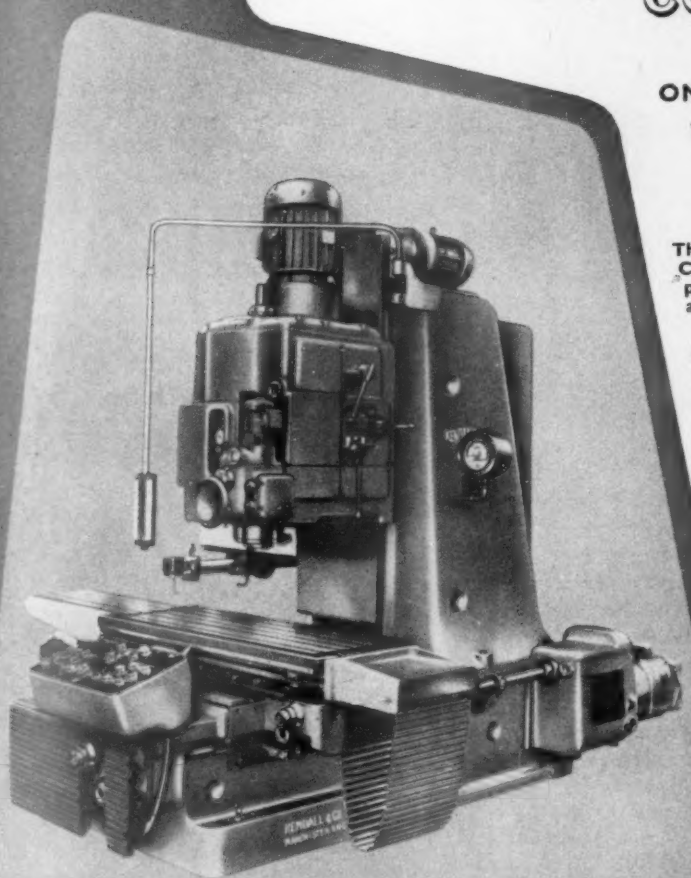
Cape Insulation & Asbestos Products Ltd.

(a Subsidiary of The Cape Asbestos Co. Ltd.) 114 & 116 Park Street, London W1. Telephone GROsvenor 6022

TA 5104

PROFILING & STEERING CONTROL

ON THE CVM15 TWO-DIMENSIONAL COPY-MILLING MACHINE



These recent additions to our range of CVM Vertical Milling Machines have passed all tests with flying colours and are now available for early delivery.

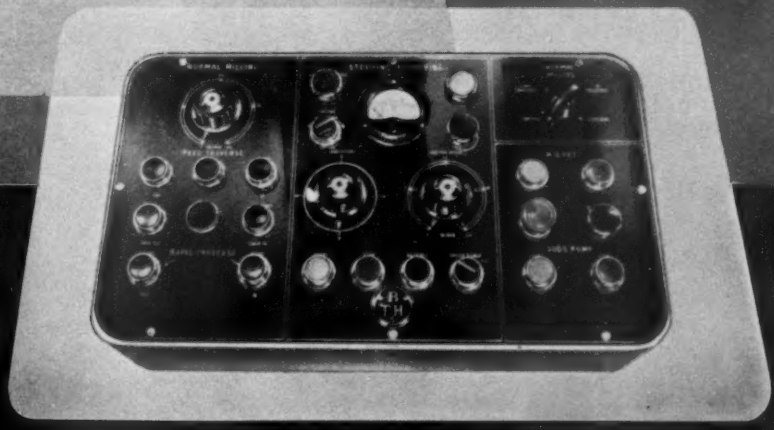
COPY MILLING

Copy milling of two-dimensional contours is achieved through automatic electronic control of the table traverses. This technique is applicable to workpieces within the capacity of the machine table.

STEERING

When milling complicated shapes simultaneous control of longitudinal and transverse table feeds allows direction of travel of the cutter in relation to the work to be "Steered" through 360 degrees. This increases cutting efficiency by eliminating idle traversing of the table.

Working surface of table	54in. x 16in.
Spindle Nose to Table	Min. 1¼in. Max. 24in.
Spindle Driving Motor	10hp.
Spindle Speeds	up to 1600 rpm
Table Feeds	up to 48 ipm
Table Rapid Traverse	72 ipm



KENDALL & GENT LTD

GORTON MANCHESTER

Phone EAST 3282

K.257-1

portable welding equipment

for continuous jointing of long welded rails

Developed for use with the system originated by British Railways, this lightweight plant comprises a welding generator, a profile grinding machine and a vertical milling machine. It can therefore carry out the entire process of welding in situ, dressing, profile grinding and milling in an average time of 30 minutes per pair of rail joints for two operators.

The welding generator, driven by a governed 25 h.p. air-cooled engine, provides 300A continuous, with a maximum of 400A. Engines can be supplied for running on petrol or propane gas. The auxiliary generator gives 27.3A at 110V d.c. for operating auxiliary equipment. The complete assembly is mounted in a wheeled tubular frame with all controls, the total weight being about 965 lb. A pair of tubular detachable handles is provided for manœuvring the unit on the site.

After the weld is made, excess metal is removed by a portable Flextol flexible shaft grinder. The Flextol Profile Grinder attachment is then clamped to the rail, and its flexible grinding belt gives a contour accurate within 0.005". The Vertical Milling Attachment then removes from the base of the rail the steel strip used to retain the weld metal.

Whilst primarily intended for jointing rails, the welding plant is equally suitable for other welding work where a high output is required from portable equipment.

Flextol POWER TOOLS

Full particulars from

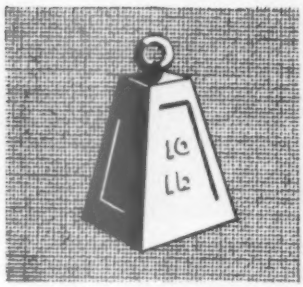
FLEXTOL ENGINEERING COMPANY LTD

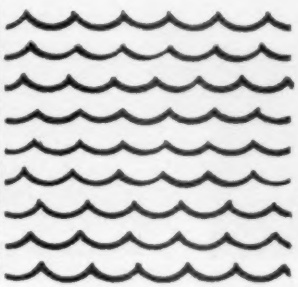
THE GREEN · EALING · LONDON · W5

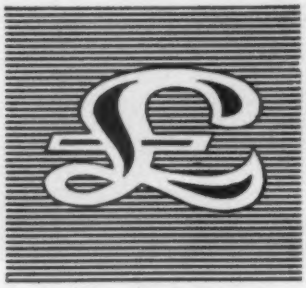
Telephone: EALING 6444/7 *Telegrams:* DOMINATING, EALUX, LONDON

AP 311

SAVE







weight · water · space · cost!

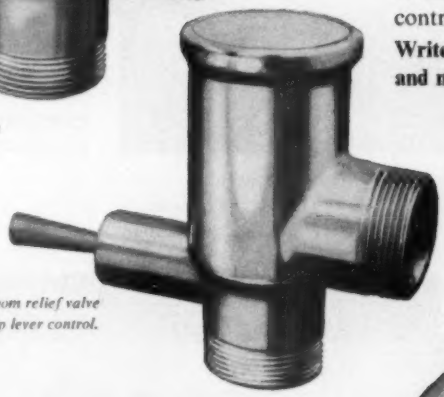
Neat, light and space-saving, Wild Lavatory Flushing Valves operate at maximum efficiency with the minimum use of water. The prescribed amount of water for flushing—it can vary from ½ to 2 gallons—is strictly regulated and the valves will function satisfactorily down to a 3 ft. head of water.

The trouble-free operation of these valves is determined by basically simple design, ensuring positive re-seating and instantaneous action. This same simplicity eliminates the need for small bye-passes so there is no risk of clogging.

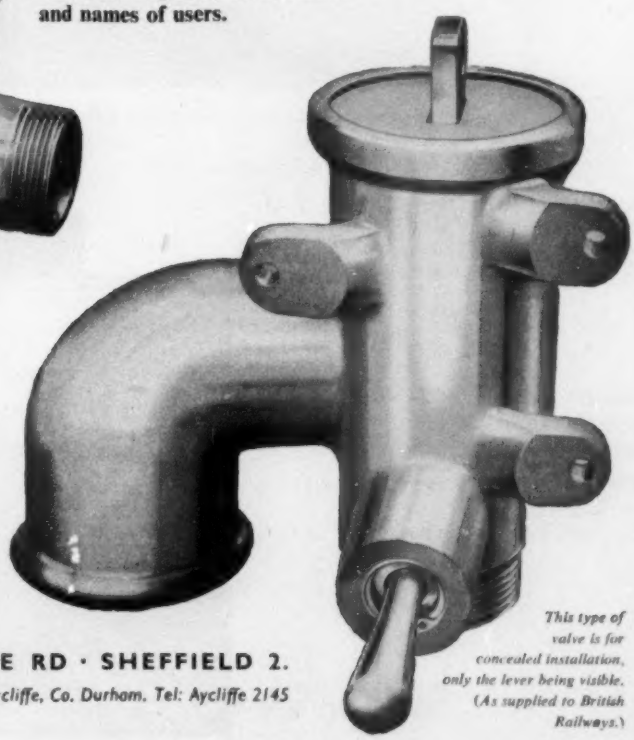
Available with trip lever or push button control as illustrated.

Write for explanatory literature and names of users.

Mushroom relief valve with push button control.



Mushroom relief valve with trip lever control.



This type of valve is for concealed installation, only the lever being visible. (As supplied to British Railways.)

FLUSHING VALVES by WILD

A. G. WILD & CO LTD · CHARLOTTE RD · SHEFFIELD 2.

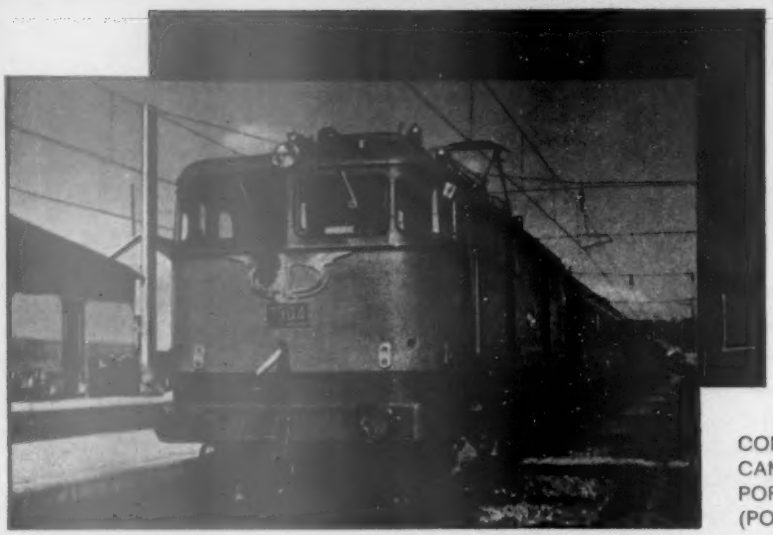
and at Aycliffe Trading Estate, Aycliffe, Co. Durham. Tel: Aycliffe 2145

AW.145

D

GROUP's Scope of Activity in 50 cs A.C. Railway Electrification:

Locomotives
Motor-Coaches
Substations
Overhead Lines
Signalling
Telecommunication



COMPANHIA DOS
CAMINHOS DE FERRO
PORTUGUESES · CP
(PORTUGUESE STATE RLY.)

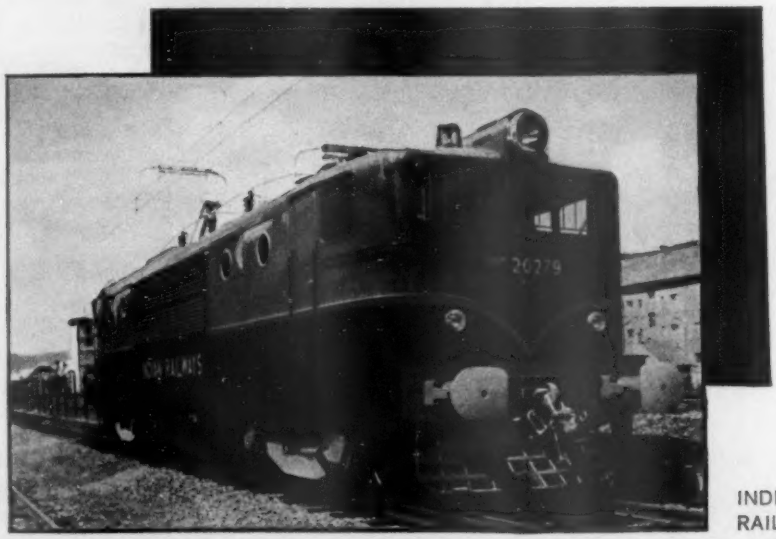
15 Bo'Bo' Mixed Traffic Locomotives Class 2500 with Ignitron Rectifiers in Operation
20 Further identical Locomotives under Construction

COMPANHIA DOS
CAMINHOS DE FERRO
PORTUGUESES · CP
(PORTUGUESE STATE RLY.)

25 Three-Coach Multiple-Units Class 2000 for Suburban Service in Operation
24 Further identical Multiple-Units under Construction

Under Construction
MAGYAR ÁLLAMVASUTAK · MAV
(HUNGARIAN STATE RLY.)

7 B'B' Mixed Traffic Locomotives
Class 3500
with Silicon Rectifiers



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RAILWAYS

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The Railway Gazette October 20, 1961

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GROUPEMENT D'ETUDE ET D'ELECTRIFICATION DE CHEMINS DE FER EN MONOPHASE 50 Hz

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China
India
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Pakistan
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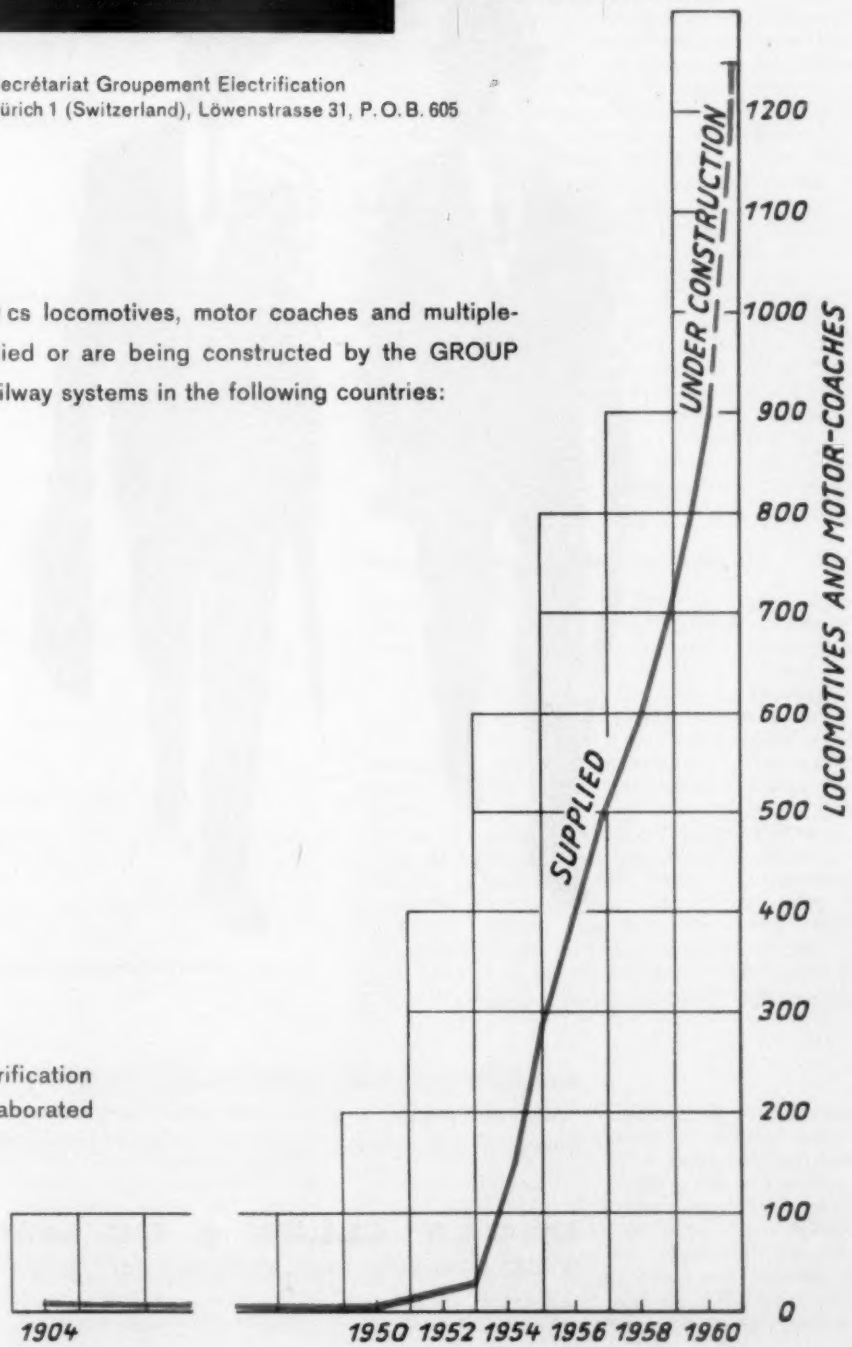

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An international journal of management, engineering and operation

VOL 115 FRIDAY OCTOBER 20 1961 No. 16

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Annually £5 by post Single copies, two shillings
Registered at the G.P.O. as a newspaper. Entered as second-class matter in U.S.A.

Need to stimulate exports

THE results of the twelfth Federation of British Industries' enquiry into industrial and export trends cover the four months June to September inclusive. It was in the middle of this period that the Chancellor introduced his "little Budget," and the replies of 686 respondents showed that significant changes have taken place in the industrial scene. Business optimism has lessened, and although the returns indicate that the trend of output has been slightly upward, there has been a deterioration in the order position. More firms reported that they were working below capacity or had more unused capacity and more reported a decline in the rate of new orders than an increase and more a shortening than a lengthening of order books. This is in contrast with the upward balances that were reported last June. In contrast to the pessimism reflected in the home market views on export prospects are fairly closely balanced between pessimism and optimism, but there seems to have been a slight downturn in the rate that new orders were received and more reported lower prices than higher. It seems clear that there is a very real need for the Government to take steps to stimulate exports if success is to attend its avowed objective of bringing about a substantial increase in this field. The F.B.I. report shows that finance has become a more important factor in exporting and that delivery dates slightly less so. Meeting competitors' prices continues to be the outstanding difficulty. The cost of finance for export is still very high, notwithstanding the recently slight reduction in Bank Rate. This cost is necessarily reflected in the difficulty of meeting the prices quoted by competitors, and is one direction in which the Government could give substantial assistance in meeting the very real difficulties of British manufacturers who wish to promote sales overseas. The cost of finance in this country, coupled with the difficulty of ensuring sufficiently long-term credits, places the British manufacturer at a very real disadvantage in competition for overseas business. All too often these combined factors are decisive in the decision by the buyer as to the placing of the contract.

More World Bank money for India

THE World Bank has approved a loan to India equivalent to $50 million to assist the development programme of the Indian Railways. The loan will go some way towards meeting the cost of equipment and materials to be imported over the coming year. Five commercial banks are participating in the loan, without the World Bank's guarantee, for a total of $1,075,000, covering the entire first maturity, which is due February 15, 1965, and part of the second maturity, due August 15, 1965. The Third Indian Five-Year Plan, which began in April this year, gives a very prominent place to the development programme of the Indian Railways. Since Independence, continuous and heavy expenditures, first on post-war rehabilitation and then on modernisation and expansion, have been undertaken by the Indian Railways. During the Second Five-Year Plan period (1956-61) the railways invested the equivalent of $2,300 million. The World Bank, even before the present loan, had provided $329 million to meet the foreign exchange needed for imports of equipment and services.

Future spending

ALTHOUGH as a result of the expenditure which has been undertaken, the railways' dependence on imported equipment has been reduced considerably, it is estimated that $400 million will have to be spent on foreign goods and services between now and 1966. Over the next five years more than 1,800 locomotives, nearly 7,900 passenger coaches, and 117,000 wagons are to be brought into service. Large sums will also be spent on workshops, track, bridges, traffic and signalling works and equipment, electrification, and the addition of about 1,200 miles of new lines to the system. The greater part of the foreign

exchange cost of this programme will have to be met over the next two or three years. The Indian Railways, which are owned by the Central Government, are managed on commercial lines by a statutory board and have operated consistently on an economic and profitable basis.

The Channel tunnel

A PRESS conference was held on October 16 at the headquarters of the British Transport Commission, by the Channel Tunnel Company, to explain the construction and operation of a Channel railway tunnel. Mr. A. B. B. Valentine, Member of the British Transport Commission, said that a decision on whether there was to be a tunnel or a bridge was urgent,for on it depended the necessity for the Commission to embark on big expenditure to extend present sea facilities. He said that the Commission, which has held 25 per cent of the equity since the company was formed, was in favour of a tunnel—this would provide competition on short sea crossings, but better business for British Railways. The French Government had declared itself in favour of a bridge and it was understood that talks had been arranged for the middle of next month between the British and French Governments, at which both projects would be discussed. Mr. A. F. L. d'Erlanger, Chairman of the Channel Tunnel Company, said that a bridge would cost twice as much as a tunnel and would not be anything like as attractive a proposition.

Britain's rail speed recovery

SO EXTENSIVE have been the accelerations in this winter's timetables that on five of the six Regions the number of runs scheduled from start to stop at 60 m.p.h. or over and their aggregate mileage are greater than before the outbreak of war in 1939. At that time the London & North Eastern Railway scheduled 23 such runs, totalling 2,896 miles; today the figure for the Eastern and North Eastern Regions is 45 runs covering 3,932 miles in all. On the Western Region there has been an even more striking increase, from the 24 runs of the Great Western Railway aggregating 2,187 miles in 1939 to the present Western Region 44 runs over a total of 3,520 miles. The Southern Railway formerly tabled no mile-a-minute runs; today the return journey of the "Atlantic Coast Express" accounts for four runs covering 319 miles, while the Scottish Region, almost exclusively with diesel multiple-unit trains, can show 14 runs over 243 miles as compared with none north of the Border in 1939. Only on the London Midland Region, hampered by massive time recovery allowances due to engineering slacks during electrification, is the position totally different from that before the war; the former 68 runs totalling 6,902 miles has shrunk to 16 daily runs only, mainly on the Midland Lines, with an aggregate mileage of 1,151.

Non-ferrous metals in transport

THE central feature of the entrance hall of the British Government Pavilion at the German Industries Exhibition now being held in Berlin is a foundry crucible. This exhibit depicts the contribution made to modern industrial development by the British non-ferrous metals industry. Emphasis is given to the use of these metals in transport, which is the main theme of the exhibition. The interior display has been produced by the Central Office of Information with the co-operation of many industrial companies and demonstrates that Britain exports a wide variety of manufactured goods as well as giving examples of many achievements in recent years in the use of non-ferrous metals. The railways section shows the part which has been played by Britain in the adoption of the latest techniques. Shipping is represented by exhibits illustrating passenger liners. A feature is made of the importance of British research and development, especially in the production of alloys of high strength and temperature resistance.

C.P.R. augments computer

THE Canadian Pacific Railway has augmented its integrated data processing system with an IBM 7080 electronic computer. This replaces the Model III 705 which in turn had succeeded earlier and less powerful installations back to the railway's first system installed in 1957. The IBM 7080 is fully transistorised and can produce management reports, process payrolls, and handle the great mass of data required in day-to-day railway operations up to six times faster than could the previous computer. Because of its great flexibility, it will be able to take up exactly where the 705 Model III left off—the programmes containing the instructions of that system can be run on the 7080 without change. Each day, Canadian Pacific's integrated data processing system keeps track of between 80,000 and 100,000 freight wagon movements. The new installation will allow this and similar tasks to be handled with ease and permit further applications of computer working.

East African receipts during August

TOTAL earnings from East African railway and harbour services during August, 1961, were approximately £2,235,000 compared with £2,118,000 in the same month last year. Railway earnings were £67,000 and harbour earnings were £46,000 above the levels estimated for the month under review. Approximate railway revenue amounted to £1,757,000; an increase of £91,000 or 5 per cent. Receipts from goods traffic increased by £97,000; road services receipts by £1,000, and miscellaneous earnings by £2,000. Hotels and catering receipts fell by £4,000; passengers and other coaching by £3,000; livestock by £2,000, and water transport by £1,000. Public goods traffic railed up-country from Mombasa mounted to 112,000 tons, an increase of 26,000 tons. Remaining about the same from Mtwara, public goods traffic railed up-country from Dar-es-Salaam and Tanga also increased over last year's figures.

Canadian Railways in 1960

ROUTE-MILEAGE of all railway tracks in Canada at the end of 1960 totalled 59,042 miles, a decrease of 351 miles on the mileage at the end of 1959. Of the 1960 total, 44,029 miles (44,209 in 1959) were first main track; 2,288 (2,350) were other main track; 1,248 (1,219) were industrial track; and 11,628 (11,616) were yard tracks and sidings. At December 31, 1960, goods wagons owned or leased by common carrier railways operating in Canada numbered 191,553 units, a decline of 2,959 from the 1959 total of 194,512. An additional 5,031 privately owned wagons brought the total number in freight service in 1960 to 196,584. The number of vehicles in passenger service decreased to 5,119 units from 5,456. There was a continued growth in the number of diesel locomotives and a sharp drop in steam, resulting in a decline of the total number of units in service. New locomotives placed in service numbered 166, and 1,135 units were retired. Coal and oil-burning steam locomotives numbered 403 at December 31, 1960, against 1,514; diesel units, 3,308 against 3,155, and electric locomotives, 41 against 51.

"Crush-loading" on the C.N.R.

CANADIAN National Railways has coined the phrase "crush-loading" to describe its plans for commuter services centred on Montreal. These will involve the disappearance of the comfortable seats now provided and their replacement by benches, more standing room, and grab poles and rails. The conversion will be carried out as an expedient because of the growing number of commuters: at present these amount to 200,000 daily. Of these, 13,000 use the services within the morning and evening peak periods. Existing coaches accommodate 92 seated passengers and 45 standing, making a total of 137. The redesigned accommodation will provide places for 95 seated passengers and 110 standing—a total per coach of

205. The present " love seats " at both ends of each coach will be replaced by benches. The rest of the seating accommodation will be " staggered " down the centre of the coach. Existing seats provide 5 sq. ft. of space for each passenger: the benches will give only 4 sq. ft.

Electric railway exhibits in Berlin

CURRENTLY on view at the German Industrial Exhibition in Berlin (October 14-25) is an electric freight locomotive of the Federal Series E.50. This locomotive, which has already seen service on the German Railways, where it will be followed by others of the same type, was designed in collaboration between the German Federal Railways, Krupp, and Allgemeine Elektricitats-Gesellschaft. It is powered by six traction motors, one of which is on exhibition. This 16⅔-cycle motor weighs 3½ tons and will yield up to 750 kW or 1,000 h.p. The locomotive and motor will be shown by Allgemeine Elektricitats-Gesellschafts, which will also display a transparent, life-size model of a 110-kV. circuit-breaker unit which illustrates how power flowing at this and even higher transmission tensions is made and broken.

Translations of B.S.I. standards

THE reference library of the British Standards Institution contains about 100,000 overseas standards, of which something like 60,000 are in foreign languages. Exporting companies have this facility at their disposal and from time to time requests are made from inquirers assuming that translations are available of every standard issued. The B.S.I. is well aware of the difficulties caused by the absence of translations, particularly from languages which are not widely known, but to carry translations of every standard issued in a foreign language would be a tall order. Sometimes the library staff is able to help and in certain cases published translations made by foreign standards bodies are held, notably those of the German Standards Association. At present the B.S.I. has no resources to prepare translations and if companies could make available to the library copies of translations made or to be made in the future it would be of considerable assistance. If any industry or group could finance the translation of selected foreign standards for general use B.S.I. would be glad to co-operate.

Lightweight locomotive gearcase

A REMARKABLE example of weight saving will be shown on the Steelfounders' stand at the Engineering Materials & Design Exhibition, Earls Court (November 13-18). This will be a gearcase for a railway locomotive oil engine which, manufactured on a quantity production basis in B.S. 592 grade A steel and having sections of 0·20 in. tapering to 0·10 in., measures 37 in. x 35 in. x 6½ in. and weighs only 1 cwt. 2 qr. 26 lb. The advantages of steel castings, compared with forged or fabricated steel, will be demonstrated, together with 35 other examples from Members of the Association on stand No. 10B. Until recently, steel castings of this nature have often been heavier than required by strict design considerations because there has been a limit to the section thinness which could be cast. The remarkably thin sections of this casting represent a major advance as, for the first time, the sections meet the optimum design requirements without excess weight.

Road and rail integration

INTEGRATION of transport at one time was recognised in Great Britain to be one of the primary objectives of overall administration. A good deal of legislation was specifically designed towards this end. Well before the war, in the '20s, the four main-line railway companies were playing a leading part in this direction by their acquisition of substantial financial interests in the principal bus undertakings, and this was a continuing process of closer association which continued after nationalisation. The benefits of closer working and co-operation between the railways and road companies were considerable to both parties and also to the public.

Although integration, in its widest sense, cannot be said to have progressed as far as many would have wished, many of the steps that were taken certainly made for better working, and on the freight side a great deal was being done in the same direction. Up to the passing of the Transport Act of 1953, it had been intended to develop a common commercial service between the railways and the Commission-owned Road Haulage Organisation, and effectively the only disturbing influence, albeit a very powerful one, in this scheme was the " C " licensee. The Transport Act of 1953 dealt a heavy blow to co-ordination, for it provided for the denationalisation of many of the British Transport Commission's road vehicles and opened the long-distance road-haulage field to competition. In removing the Commission's monopoly, it vitally affected both the rail and road services of the Commission.

Mr. K. W. C. Grand, who is a member of the British Transport Commission as well as the President of the Institute of Transport, in a concise, interesting and extremely informative paper to the Canadian Railway Club in Montreal at the beginning of this month, dealt with the overall picture of road and rail integration. Of road and rail services in Great Britain, he explained that while integration had ceased to be the main objective of the Commission, co-ordination of the freight service schemes continued, and collection and delivery operations by British Road Services, on an agency basis, for British Railways and *vice-versa*, had been developed. He gave as examples a number of schemes which are functioning for British Road Services depots with rail access, and also referred to the success which is attending the provision of 75 services for trunk haul of British Road Services traffic in British Railways containers.

The future relationship between British Railways and British Road Services will depend on the provisions of the new Transport Bill soon to be introduced. Under the White Paper of December last, which outlined the Government's intentions for the impending legislation, it was proposed to dissolve the Commission and that each of its main activities should be managed by a separate board. Co-ordination of policy between the new boards would rest with the Minister, advised by a Nationalised Transport Advisory Council. Mr. Grand said that suitable arrangements would also be established for co-ordinating the day-to-day activities of individual undertakings, including rail and road services, but added that at this stage it was not possible to do more than speculate as to the degree and field of co-ordination in the future.

Although there are, and will remain, many traffics which are clearly best carried by one or another means of transport, for most traffics adequate services can be provided by road or rail or both, and it is important to see whether a combined road/rail service can be provided which overall is more efficient than either separately. Mr. Grand gave his audience details of the varying kinds of schemes in operation by the British Transport Commission for the movement of traffics, and emphasised, particularly, the need to find some simple and inexpensive solution of avoiding transhipment. Much had been done by the development of containers, of which over 50,000 were now in service on British Railways. He also mentioned the road railer now being developed by British Railways and the Pressed Steel Co. Ltd., of which the British Transport Commission has ordered 50 for full-scale commercial trials.

It is clear that the common ownership of rail transport and part of road transport has thrown up opportunities for a pooling of resources of many different kinds, and that one of the most important is the ability to offer a trader a comprehensive transport service. It has also enabled the British Transport Commission to plan its new facilities on a joint working basis, and in all new works to take account of all forms of transport.

Mr. Grand concluded by emphasising that while it was far too early to guess at the future structure or form of organisa-

tion of transport in Great Britain, it would seem clear that even if integration was no longer an objective or a possibility, some form of co-ordination might continue to be necessary between even competitive services. That indeed is essential if there is to be avoided a duplication of resources with a corresponding surplus of transport which ultimately is to be paid for by the community at large.

Common Market factors

THE growth of the European Common Market economy and the decision of Great Britain to explore the possibility of joining the European group is, naturally, of concern to many members of the Commonwealth. Mr. N. R. Crump, Chairman & President of the Canadian Pacific Railway Company, fully understands that the well-being of railways is fundamentally associated with the general level of economy in the territories they serve. As head of the Canadian Pacific Railway, as well as being a member of Canada's Productivity Council, he is in an excellent position to assess the effects of the far-reaching changes that are taking place in European trading. Many of the remarks he made in a recent statement to the Canadian Chamber of Commerce were of far wider implication than to Canada alone, although it was in that context that he addressed his audience.

Mr. Crump stated that, in general terms, the cause of Canada's economic ills was the failure of the economy in recent years to grow rapidly enough to employ fully the productive resources of the economy. The reason for lack of growth in the economy in recent years had been competition abroad and competition in the domestic economy from the newly reconstructed economies of Western Europe and Japan. Frequently, Canadians put heavy responsibility for problems of the Canadian economy at the door of government. Government economic policy was important, but the responsibility for economic growth was not that of government alone. In general, the Canadian economy had not been built by government; it had been built by businessmen. The role of government in Canada traditionally had been to provide the environment within which private enterprise could develop. Now, as has been the case for the past 75 to 100 years, it was not government action which would develop the Canadian economy. Rather it was the action of Canada's businessmen and her entrepreneurs.

Unlike North America, Europe had emerged from the last world war with a substantial part of her productive capacity in ruins. On the foundation of these ruins, new efficient manufacturing plants had been built. It frequently happened that, in addition to lower wage rates, European manufacturers were producing with newer, more efficient, less labour-intensive equipment than their North American competitors.

Nor was this all. The post-war years had seen emergence in Europe of dynamic and powerful trading blocks. The effect of these had been to create two large markets out of many small ones, and to obtain, through more widespread competition, production at lower cost. The aim of the trading blocks was to promote economic growth throughout the area at a faster rate than the component countries could attain individually. This was being done through the steady elimination of tariffs and quotas on trade between the member countries, and in the case of European Common Market, equalisation of the external tariffs.

The success of the Common Market appeared to have exceeded by far the fondest expectations, to the point that the United Kingdom and other members of the European Free Trade Association were considering membership. The biggest offsetting feature to Canada of the Common Market was the rapidly increasing prosperity of its member countries. More prosperous customers are in a position to buy more. In certain areas Common Market demand might increase faster than ability to supply from within the Common Market. The Common Market offers both challenge and opportunity for Canada. Canada's short-term trading prospects would not be helped if Britain joined the Common Market. In the long term, if Canada could develop new products, aggressively market, and keep close control over costs, the increased prosperity in Europe should stimulate rather than depress its trade. It was necessary carefully to examine the markets and institute positive cost control programmes. No longer could Canadian Labour follow policies which tended to push upwards the prices of goods and services. Labour had to face the problems as squarely as Business.

Planning main-line electrification

IN a talk to the London Midland Region Lecture & Debating Society, Mr. F. L. Lambert, B.Sc., M.I.C.E., Planning Officer, Euston, London Midland Region, British Railways, described some of the work involved in the electrification of the Euston main line. His remarks were confined to the planning of the design and to the execution of that site work which is largely the responsibility of the Central Staff of the Commission. He stated that the work involved the almost complete reconstruction of one of the most densely-worked railway lines in the world, on which traffic must be kept moving throughout the eight years of the operation and without extensive planning before the work started.

Mr. Lambert described the electrification project, detailing some of the figures indicating the magnitude of the task. Excluding rolling-stock, the total cost of the works was estimated at £110 million. The first experimental stage from Manchester to Crewe cost £15 million. The lines from Liverpool to Birmingham and London would have to be carried out on the remaining £95 million. This part involved about 450 geographical miles of track to be wired in seven to eight years at about £13 million a year and reaching £17·8 million in 1964. The total expenditure was divided; civil engineering would account for £34 million, signal and telecommunications engineering, £33 million; mechanical and electrical engineering, £28 million.

Mr. Lambert also described changes to be made in tunnels, overline bridges, and similar structures and alterations planned for signal and telegraph systems made necessary by the presence of the high-tension traction system. Included were the replacement of numerous semaphore signals unsighted by new structures. The system of signalling would also have to be brought thoroughly up to date in line with requirements of the faster and heavier traffic the new system would carry. Allied to the faster and higher capacity system was the modernisation of stations and wayside stuctures generally.

Following experience gained on the Crewe-Manchester section, it became evident that, if work was carried out at a number of points simultaneously, the benefits of electric traction could be obtained more quickly. The work was therefore divided into 11 major sections and 44 smaller items. Work was planned to proceed simultaneously on all these. Planning of operations had to be carefully carried out to achieve freedom from delays and avoid interference with traffic.

Planning of existing timetables entered into the last factor to avoid having too many delays on any one given route. Train crews, lookout men, and hand-signalmen had to be provided and extra wagon requirements. In some cases up to 1,000 in one section over a weekend had to be met.

The Planning Department had to take into account all these divergent requirements and prepare work charts accordingly. Also to be included were the 44 smaller items, which had also to be "progressed" in a similar way to achieve the required interlocking between departments both as to equipment requirements and as to dates of completion of the stages of completion of the works. An example of this type of planning was cited by Mr. Lambert.

The lineside buildings house switchgear for the traction current and transformers for the signalling equipment. Ducting

for both sets of cabling forms part of the structure of the building. Planning of the circuits must therefore be complete before the erection of the building, which must be erected long before the remainder of the traction supply work or the signalling details need to be even finalised. Thus two groups of engineers must advance their work considerably to enable a third group to work efficiently. An "exchange of documents" schedule had been devised in which dates for the exchange of information were laid down. The supervision of this schedule and its amendment formed the first part of planning office work.

Irish winter train services

IN the winter timetable of Coras Iompair Eireann, which came in operation on September 11, the rising importance of Limerick is marked by a still further improvement in the service between that town and Dublin. In the summer timetable the 8.55 a.m. from Dublin Kingsbridge to Tralee, in previous years non-stop to Mallow, was stopped at Limerick Junction to provide a connection to Limerick. With the customary winter withdrawal of the 8.55 a.m., the non-stop Dublin-Cork run of the 8.45 a.m. " Slainte " diesel express is now broken by a Limerick Junction stop (10.40-10.42 a.m.), without increase in the 3-hr. timing to Cork, to make the Limerick connection, which reaches that town 15 min. earlier, at 11.15 a.m. The time of 2½ hr. from Dublin now equals that of the 6.30 p.m. from Limerick, which feeds at Limerick Junction into the 6 p.m. 3-hr. train from Cork to Dublin; and both give the fastest times ever yet scheduled between the two cities.

The 12.5 p.m. from Limerick to Limerick Junction also has been altered to 12.15 p.m., and gives a time of 2¾ hr. to Dublin, 10 min. faster than before. As usual in winter, the 2 p.m. from Dublin to Limerick *via* Nenagh and the 11.50 a.m. return train have been withdrawn. The Sunday 9 a.m. from Cork to Dublin now starts at 9.30 a.m. and runs 30 min. later throughout, as also the 9.40 a.m. connection (now 10.10 a.m.) from Limerick to Limerick Junction. On the Tralee line, the 9.35 a.m. from Tralee to Mallow now starts at 9.50 a.m. and is accelerated to reach Mallow 4 min. later only, with the fast connection arriving in Dublin at 3 p.m. as previously. The former 1.40 p.m. from Tralee also starts 10 min. later, but with no alteration in the time of the mail connection from Mallow to Dublin.

On the Galway line, the accelerations effected in the summer have been made permanent. As compared with last winter, the 9.20 a.m. " Cu na Mara " diesel express from Galway starts at 9.25 a.m., but still reaches Dublin Westland Row at 12.35 p.m., and the 3.30 p.m. from Galway starts 15 min. later, but is into Westland Row 5 min. earlier, at 7.35 p.m., so accelerating the service from Galway line stations in connection with the Holyhead steamer from Dun Laoghaire. The former 6 p.m. from Westland Row to Sligo starts at 6.15 p.m., and picks up its previous times shortly after Mullingar. The Westport portion of the diesel " Cu na Mara " express leaves there at 8.10 a.m., 10 min. later than last winter, but with unchanged Dublin arrival.

On the Dublin & South Eastern section last winter's 10.20 a.m. from Rosslare Harbour and 11.45 a.m. from Wexford North to Dublin start at 9.20 and 10 a.m. respectively, with a Westland Row arrival at 1.28 instead of 3 p.m., and Amiens Street at 1.35 instead of 3 p.m.; this also was a change introduced with the summer timetable, and one which permits this train to connect with the 2.30 p.m. from Westland Row to Athlone and Westport.

On the joint C.I.E.-U.T.A. Dublin-Belfast service, the 5.30 p.m. " Enterprise " from Dublin Amiens Street to Belfast has resumed its stop at Dundalk (6.28-6.29 p.m.) to pick up passengers only, which has been suspended during the summer, and without alteration of its 7.40 p.m. Belfast arrival. The 4.45 p.m. " Enterprise " from Belfast to Dublin retains its 5 min. summer acceleration, and is now a 2 hr. 10 min. train, similar to the other " Enterprise " workings. The 3 p.m. from Belfast to Dublin has resumed its usual 2.15 p.m. winter starting time, with an Amiens Street arrival at 5.5 p.m.; but the 6 p.m. from Belfast is starting 15 min. later, and has been accelerated 10 min. to reach Dublin at 9.10 p.m.

The gathering transport storm

BY A CORRESPONDENT

UNDER this title the Association of American Railroads has issued a booklet of 26 pages to explain, with the help of graphs, the crisis which has arisen over transport policy in the United States. In the first six months of this year, 33 Class 1 railways failed to cover fixed charges. For the half year, the net income of all Class 1 railways was only $60 million out of gross revenues of $4,419 million; in the Eastern District there was a net income deficit of $74 million in contrast to net earnings of $65 million in the first half of 1960.

The A.A.R. pamphlet points out that railways are the most important commercial carrier in the States moving 46 per cent of inter-city freight traffic and 28 per cent of passenger travel. Last year they employed 780,000 people, who were paid nearly $5,000 million. They spent $2,500 million on equipment and supplies and paid $1,000 million in taxes of all kinds. The railways are economical in the use of fuel and manpower, handling over three times as much traffic per gallon of fuel as road hauliers and 58 times as much as airlines. A railwayman handles five times as much traffic as a road transport worker and 20 times as much as an airline employee. The superior productivity of rail service would be crucial in a national emergency. In the last war railways doubled their freight traffic and quadrupled their passenger volume.

Since the war the railways have not secured a share of the expanding freight traffic offering. In 1960 railways freight volume was 4 per cent less than in 1946, while road haulage rose to more than 3½ times the pre-war level and freight traffic on rivers and canals multiplied to over four times the old level. Over the post-war years the competition of private motorcars and subsidised airlines ruined passenger railway services.

Between 1946 and 1960 the railways spent $16,100 million on improvement programmes, which raised the standard of operating efficiency but left them with a return of less than 3 per cent on net assets, the poorest result for any industrial group or public utility. A painful outcome of rail losses was that by June, 1961, over half a million jobs had disappeared, and rail supply industries had been badly hit.

The pamphlet blames Government policy inequities for their precarious position, stressing that two thirds of road traffic and nine-tenths of barge traffic are unregulated, so that of all general freight hauliers, only the fully regulated railways have lost business. Federal outlays have expanded their competitors' undertakings, while the railways receive nothing.

Inadequate depreciation allowances are another handicap to the railways. Airlines can recover their investment in new planes in five years, buses can be written off in seven, but invested capital in freight wagons is written off in an average of 28 years and structures in up to 100 years. These arrangements make it difficult to accumulate capital for replacements.

The pamphlet sums up the A.A.R. remedies in eight legislative goals, which it terms " Magna Carta." These are:—

1. Establish a National User Charge Commission to collect fees for commercial use of tax-built facilities.
2. End discriminatory state-local property taxes.
3. Shorten tax write-off period for new investment to stimulate plant modernisation.
4. Repeal 10 per cent excise tax on travel.
5. Remove restrictions that prevent carrier diversification.
6. Repeal regulatory exemption given trucks hauling agricultural goods—or extend to railways.
7. Repeal exemption given barge lines hauling commodities in bulk—or extend to railways.
8. Keep rate regulation from being used to deprive public of benefits of low-cost transport.

LETTERS TO THE EDITOR

THE EDITOR IS NOT RESPONSIBLE FOR THE OPINIONS OF CORRESPONDENTS

RAILWAYS INTO ROADS

October 7

SIR, The controversy "Railways into Roads" has occupied a great deal of space in your columns. The lively exchange of statistics has certainly obscured the issues. Some of your readers are certain to have noticed that the "Railways into Roaders" are not a homogeneous group with similar aims even though they themselves may think so. A retired brigadier is probably thinking the conversion will make it easier to smuggle his Mini-Minor into town; a haulage contractor, on the other hand, may very well be attracted by the prospect of a secure profit with a minimum of capital rise.

Both of these views have their legitimate claim in a free government but are dwarfed by the problem of how best to keep London and its surroundings a vital, growing, and worthwhile place in which to live and work. London is to my foreign eyes still perhaps the greatest of cities in the universal sense that it is productive of both material and spiritual value to a greater extent than most of its contemporaries, however serious its drawbacks and irritation seem in detail of experience.

The solution of these problems should not be harnessed to such a naive and reactionary scheme. If private vehicle expressways are the solution, there is a body of experience in the United States which can be consulted and forward-looking plans made for laying them on. The inevitable result of doing things in a mindless way is endless trouble, if not disaster. Los Angeles, which got into the expressway development business by inadvertance, has finally calculated the cost of finishing (?) the task at $4,000 million. The fact that for practical purposes almost everyone has a private car lends a certain homogeneity to the civic will to get this done.

Despite the enormous increase in ownership of private cars in Britain, one wonders whether such expenditure is beneficial to the public at large. The enormous expansion of private motor vehicles in America has not really arisen from a surplus of earning power for sporting luxury but simply from the fact that there is really no other way to get around. The growth of the motor population is destroying what was useful of the earlier means, whether rail or water, and other values as well.

The self-propelled commuter has to perform functions that can often be more capably done by a trained specialist. One just cannot read the morning paper and drive. It is technically feasible at present to equip private cars and roads for automatic control. This may have to be done here to reduce the hazards resulting from the unequal capabilities of individual motorists in mass traffic densities, which some of your correspondents quote as theoretically possible. This will add to the mounting expense of private transport. One will have to equip or be denied access to the best roads. We shall have to face this before London is adequately equipped for motor circulation. Before everybody denounces me for cheek I will quickly state that London might still remain the finest city in the world if every effort were to be made to make the present London Transport, supplemented by British Railways, the most efficient and best integrated system in the world, so that there would be not one single private vehicle around. If the eventual costs of providing for the freedom of movement of every single citizen in his private vehicle were studied, it is conceivable that everybody could be provided with free transport at less overall cost.

This does not explain the fishy smell of the "Railways into Roads" scheme to me. I wonder whether one ought not to be wary of the whole business. One can be bested at the tricky game of statistics; a raid on the public domain is still a raid. If the railways were still in private hands the cost of acquiring the rights of way for conversion would preclude anyone but a lunatic fringe from taking the idea seriously. It is your problem, gentlemen. Don't waste your force on statistics; blast away at the motive.

Yours faithfully,

R. W. CHALFONT

704, Cathedral Street,
Baltimore 1, Maryland

October 11

SIR, Attached is a news item taken from the *Daily Mail* of October 4 last.

"The M.1—241 accidents, 22 deaths—was the safest "fast road" in Britain last year, says a Transport Ministry report issued yesterday."

It would be interesting to hear what ingenious explanation Brigadier Lloyd puts forward to persuade rail travellers to accept risks of this order (or worse) on his converted railways.

Yours faithfully,

N. D. BALL

6, Strand Close,
Epsom Downs, Surrey

October 1

SIR, To arrive at the number of buses required to replace B.R's train services, after the railways serving central London have been converted into roads, Dr. Daniel merely divides the maximum hourly flow of rail commuters by the seating capacity of a bus, as if each bus could make only one journey in 60 minutes. In fact, the average peak-hour rail commuter lives only about 12 miles out from the central termini, and the average bus on these services will therefore be able to make two trips in the hour. Accordingly B.R's peak-hour load of 240,000 passengers will fully occupy a fleet of 2,000 buses of 60-seat capacity, not 6,000 which was the figure Dr. Daniel introduced. "Three times is a lot," someone once said; anyway, it is a sizeable error in a reputedly technical correspondence.

Again, Dr. Daniel would have us believe that it takes the same number of men to run a bus as a train: he matches bus driver and conductor against motorman and guard. But what matters, of course, is the overall length of the firm's pay roll. The Provincial and Scottish bus services of the B.T.C. employ a total of 57,407 persons to operate 14,013 vehicles, an average of 4·1 per vehicle. British Railways claim to operate some 23,000 passenger trains and 17,000 freight trains per weekday; these are actually train-runs, of which many will be made by the same train; but even if B.R. were regarded as having a fleet of 40,000 trains, their employees would still amount to 12·9 per train. And do not let it be imagined that freight necessarily requires proportionately more staff than passenger traffic: British Road Services employ 36,458 persons to operate 22,606 vehicles, which is only 1·6 per vehicle, showing that cargo handling, maintenance work and administrative overheads do not, in this form of transport, loom large in relation to the bare movement costs. They do loom large—enormously large—in rail transport. That is the trouble. Indeed it provides one of the basic reasons for doing away with rail transport.

Yours faithfully,

T. I. LLOYD

24, Grove Road, Merrow,
Guildford, Surrey

The Scrap Heap

Wagon train ?

Mr. James Robertson, who celebrated his 103rd birthday recently, claims to have fought Red Indians while he was engaged on the construction of the Canadian Pacific Railway.

Pressure point

The editorial reference this week to "crush-loading" on Canadian National Railways trains brings to mind a comment on the London Underground made some years ago by Ted Ray, the British comedian. "There was such a squash on my train," he said, "that it was almost fun!"

Lost monkey

At Waterloo Station on the Southern Region of British Railways recently the staff in the Lost Property Office were startled when a marmoset was handed in. It was sent to the headquarters of the Royal Society for the Prevention of Cruelty to Animals.

Brief parting

Mr. Norman Skelhorn, Q.C., lost a homburg hat, a raincoat, a law book, and two suitcases on a journey to Plymouth recently, when the train on which he was travelling divided at Newton Abbot. The railway authorities managed to trace the missing articles and return them to Mr. Skelhorn without delay.

Conscience

The London office of the German Federal Railway recently received a letter and a metal plate bearing the words "Nicht Linauslehnen" (do not lean out). The letter read:

"Dear Sir, I have been meaning to return this ever since I removed it from a train in Germany in 1953. Please accept my apologies for my foolishness. Yours faithfully, an Englishman."

Missing station name

The name-sign from the Anglesey Station with the longest name, shortened to Llanfair P.G., disappeared during last week-end. The sign, which is made in three sections with a total length of 19 ft. 8 in., was found on the playing fields at Reading School. This is not the first time that the name board has been misappropriated, the last time was last year when it turned up at a Manchester University Rag Week.

Gates to be preserved

The Secretary General of the British Transport Commission, Major General Ll. Wansborough-Jones has written to the Secretary of the Ancient Monument Society giving an assurance that the gates of the Doric Arch at Euston will be preserved. The Chairman of the society has offered to accept the gates for safe custody and re-erect them at Gawsworth, Cheshire, on his own property.

Old engine in steam again

Lion, a locomotive built in 1838, which now belongs to the Liverpool Engineering Society and usually stands in Crewe railway works museum, ran under its own steam on British Railways, on October 18. The locomotive will be featured in the Midlands programme of Associated Television on November 3 entitled "Look Around."

British Railways standard

The illustration shows a small standard designed and distributed by the Public Relations & Publicity Officer of the North Eastern Region of British Railways to travel agencies and enquiry offices within the Region for counter or window display. The flag is 12 in. x 6 in., tangerine in colour, and bears the slogan "First in the world in 1825—and still showing the way." Also depicted on the flag is the old locomotive, Locomotion No. 1 and a diesel-electric engine over a miniature map of the world.

British Railways flag for counter display

Significantly named

During the building of the East Coast Railway in British Guiana working conditions on the track were trying, for mosquitoes and sandflies were almost unbearable. The names of the first six locomotives appear to have had significance; they were, No. 1 *Mosquito*, No. 2 *Sandfly*, No. 3 *Firefly*, No. 4 *Scorpion*, No. 5 *Centipede*, and No. 6 *Marabunta*.

Left out

The fortunes of the East Coast line were watchfully observed by the *Royal Gazette* (a local newspaper) which, not having been invited to the opening of a station, observed: "There was, of course, the usual number of loyal and patriotic toasts given with the liberal supply of wine, but as no reporter was present, the eloquence has :—

Melted into air, thin air,
and like the baseless fabric of this vision,
leave not a rack behind."

Early difficulties

In 1859, the *Royal Gazette* felt moved to remark, "We would not wish our worst enemy greater evil than to be made sole proprietor of the Demerara Railway Company with an obligation to work it for a term of years." The writer observed that though he was not the proprietor, let alone the sole proprietor of the Demerara Railway, there was more to the comment of the *Gazette* than a mere *idée fixe*. Despite the slowness of construction and vicissitudes of one kind or another through which the railway stumbled, it appears eventually to have enjoyed a period of moderate prosperity during which it paid 7 per cent on preferred stock and 5 per cent to ordinary shareholders. The snail-like progress of the first 22 miles of construction spread over a period of 18 years—during which abandonment of the project nearly occurred—stands out in extraordinary contrast to the completion of 40 miles from Mahaica to Rosignol in three years.

50 years ago

In 1911 it was held by a Divisional Court that a railway company was not responsible for misdirection by its servants. The case arose when a porter on the Great Western Railway misdirected a passenger who took 13 hours to reach his destination and sued the railway company.

OVERSEAS RAILWAY AFFAIRS

FROM OUR CORRESPONDENTS

ARGENTINA

Reorganisation of the railways

So stubborn has been the resistance of the workers with a series of strikes of increasing duration that the Government has had to agree to negotiate, at any rate as a temporary measure, paralysing its action with a view to reduction of the 23,000 million pesos railway deficit. Both sides undertake to find a workable formula for the working of the ancillary services, which, as previously reported in *The Railway Gazette*, were being let out on contract. Regarding the closure of branch lines, a committee is to analyse the possibilities of each one individually, including those already closed; it will also study the reorganisation of the workshops.

Inefficiency in working to existing rules

Both sides agree that some form of reorganisation is essential, and the Government has made it clear to the unions that inefficiency is the main cause of the deficit. For instance, working to rule means a working day of 2½ to 3½ hr. Yet the men refuse to discuss any overhaul of the regulations, mainly because it would result in a 30 per cent reduction of staff, albeit without loss of efficiency.

INDIA

Farakka Ferry

The Calcutta-Siliguri (Northern Bengal) 5-ft. 6-in. gauge link at present under construction will in future cross the River Ganges on a barrage between Farakka and Khejuria but, until the barrage is constructed, it will cross the river with a wagon-ferry. This is already in service, the vessels used being those released from the Mokameh ferry as a result of the completion of the great bridge over the Ganges at that point. The ferry-barges had to be converted to carry 5 ft. 6 in. instead of metre-gauge wagons.

Khejuria to Malda and Mukuria

From Khejuria Ghat on the East bank of the river, a 5-ft. 6-in. gauge line has been constructed to Malda Court, a station on the Katihar-Kumedpur-Singhabad metre-gauge branch of the North-east Frontier Railway, which also constructed the line from Khejuria to Malda. It is further engaged on the conversion of the Katihar-Singhabad 69-mile section from metre to 5-ft. 6-in. gauge, and of the 15½-mile Kumedpur-Mukuria section.

Special wagon to carry 40 tons of electric cable on 10 reels

Completion of broad-gauge route

When these conversions are completed there will be continuity of broad-gauge traffic from Howrah (Calcutta) *via* Tildanga (on the E.R. loop line), Farakka and the ferry to Khejuria Ghat, Malda, and Kumedpur to Mukuria. To complete the broad-gauge route to Siliguri, there then remain 93 miles beyond Mukuria to be converted from metre to broad gauge or newly constructed. This work is already in hand.

VICTORIA

Special wagon for electric cable

The Victorian Government Railways administration has recently built at its Newport Workshops a special "SC" wagon. It is designed to carry ten reels of 222,000-V. steel-cored aluminium cable, each reel weighs four ton. The reels rest on curved cradles, two abreast, with double layers of hose-piping to cushion the load. The wagon will be used between Melbourne and the Kerang-Mildura high-tension power line extension area, to carry 1,200 tons of cable for the State Electricity Commission.

CANADA

Car and piggyback 1961 loadings

In Canada as a whole, during the first six months of 1961, 1,648,133 cars were loaded with revenue freight as compared with 1,796,100 during the corresponding period of 1960. It is interesting to note that piggyback loadings increased during these six months as compared with those last year by 2·9 per cent, from 77,964 to 80,247.

C.P.R. operating results for 1960

According to official figures released by the Canadian Dominion Bureau of Statistics, operating revenue per route-mile operated by the Canadian Pacific Railway in 1960 decreased by 4·1 per cent as compared with the 1959 figure. Further details of operation are given in the table below:—

Particulars	1959	1960
Total operating revenue	$523,915,000	$502,205,000
Operating expenditure	$486,251,000	$466,718,000
Freight carried	Tons 57,879,000	Tons 56,924,000
Passengers carried	No. 7,740,000	No. 7,059,000
Revenue per ton of freight	$7·02	$6·86
Revenue per passenger	$4·29	$4·32
Revenue per ton-mile	Cents 1·566	Cents 1·518
Revenue per passenger-mile	Cents 2·986	Cents 3·027
Route-mileage operated	17,096	17,094
Revenue per route-mile	$30,646	$29,378

RAPID-TRANSIT SYSTEM for San Francisco

Existing main-line routes to be utilised and an under-bay tube built

RECENTLY the authorities of the five counties around San Francisco have been considering engineering and financial plans for a 120-mile rapid-transit system for the city. If they agree that it is what is required, a referendum of the voters will be held to approve a bond issue. For the complete project under consideration five high-speed inter-urban lines radiating from San Francisco and Oakland are proposed, as are also 40-year general obligation bonds to finance the capital outlay of £38½ million. The £47½ million under-bay tube between the two cities would be financed from Bay Bridge tolls as earmarked by State legislation. Rolling stock costing £53,200,000 should be financed by revenue bonds.

Rapid transit as a regional, as opposed to a local or urban, arterial system using existing main-line routes is recommended to connect and radiate from the centres of the two cities. The proposed system is shown in the map reproduced.

The outer stations on it, most of which are intended to have parking facilities, will be fed by local road transport and motorcars. It will be noticed that the northern line will use the Golden Gate bridge. On the Concord (eastern) line a two-mile tunnel is planned through the Berkeley Hills, there crossing Haywards earthquake fault. Both of the southern arms will later be extended to San José. Proposed through services will be (1) from Concord through both cities to Palo Alto. (2) Richmond *via* Oakland to Fremont, and (3) Santa Venetia-San Francisco.

Main-line routes to be followed

All the routes will to some extent use rights of way of the Northwestern Pacific, Sacremento Northern, Southern Pacific—the only one with a commuter service in the area—Western Pacific and Santa Fe main lines.

The tube under the bay was decided upon in preference to using the tramway over the Bay Bridge, because the latter gave poor access to both cities, necessitated 30 m.p.h. train speeds, and is 3½ miles longer. The two city centres will be 8 min. apart by tube and would be 22 min. *via* the bridge. Moreover, road traffic over the bridge is so congested that it is necessary to take up the rails to increase highway capacity. In return, the highway department is prepared to allocate surplus tolls from the bridge to the construction of the tube, so that this, its most costly part of the system construction, is financially assured to the rapid-transit authority, the Bay Area Rapid Transport District, (B.A.R.T.D.) In both cities parts of the underground sectors will be four-track, two-level tubes or cut-and-cover lines. Where they are elevated they will be on T-shaped superstructures with the side parapets, presumably of concrete, to deaden noise.

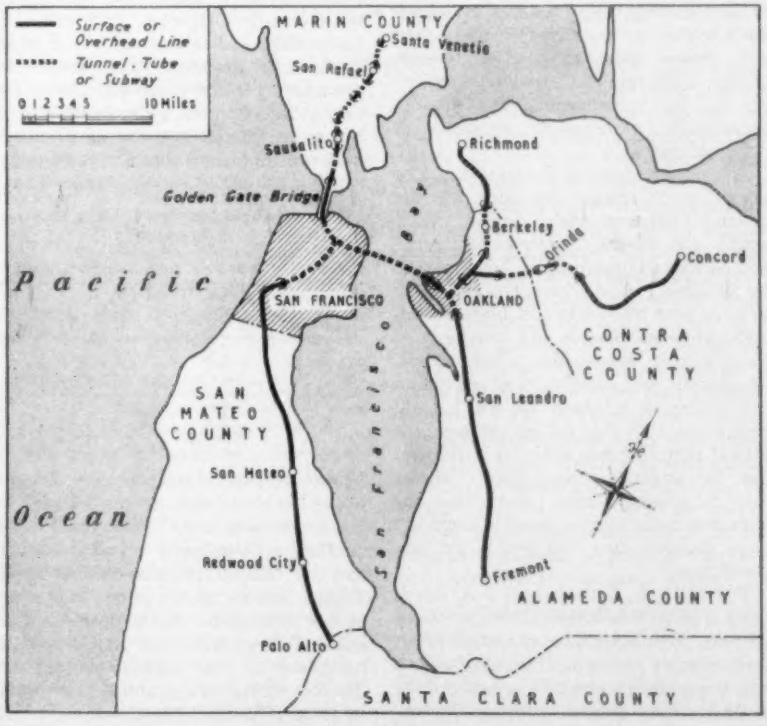
Golden Gate bridge uncertainty

In March, Mr. C. H. Gronquist, partner in the well-known firm of consulting engineers which designed the steel arch bridge over the Indus in Pakistan, reported that it was quite feasible to use the Golden Gate bridge for rapid-transit traffic. This is disputed by Mr. C. E. Paine, another consulting engineer, on the grounds that the additional loading will cause the bridge span to be depressed some 8 ft. below the 220 ft. specified headway clearance above mean highwater level, and this cannot be permitted as the clearance must be maintained.

This ruling is strongly contested by B.A.R.T.D., backed by San Francisco and Marin Counties, served by the line to Santa Venetia which must cross the Golden Gate bridge if it is to be built. They are claiming that an international impartial engineering committee should report on the matter.

Meanwhile, B.A.R.T.D. is postponing consideration of this line which does not affect the two through services (1) and (2), and is concentrating for the time being on the two latter, serving the other four counties.

The rolling-stock recommended consists of 68-ft. coaches weighing 38 tons and seating 76 passengers, running on standard-gauge bogies; some 950 will be required.



Map showing proposed rapid-transit route in San Francisco

CARRIAGE AND RAILCAR BOGIES: their design and development—VI

Conclusion of six-part article deals with the effects of track and sound intensity

by J. L. KOFFMAN, *Design Engineer (Projects), Chief Mechanical Engineer's Department, British Railways Central Staff*

No reference to track has been made so far in order not to detract from considerations dealing with bogie design. It is easy to put all the blame for poor riding on imperfect track (and no track is likely to be perfect), just as it is possible for the permanent way engineer to blame poor vehicle design or maintenance. Sweeping arguments along these lines are scarcely ever rewarding. Most vehicles are sensitive to sudden lateral or cross-level deviations, particularly at speeds in excess of 50 to 60 m.p.h. Sudden lateral and vertical/lateral accelerations induce hunting and swaying, and it is here that prevention is difficult for permanent-way and rolling-stock engineers alike. Yet prevention is essential as long as good riding is the aim at ever-increasing speeds.

Specific demands

It must be stressed that coach bogies in particular are evolved to meet specific demands imposed by overall vehicle design and to ensure good riding over the track of the railway concerned. Engineering and operating personnel pay occasional visits to other railways and sometimes return with glowing accounts of superlatively-riding vehicles or bogies. Such bogies are then sometimes acquired and placed under indigenous vehicle bodies. The results are often disappointing to the reforming spirits, though occasionally a relief to members of "the old guard."

The reasons are not far to seek. The bogies might remain the same but the distance between their centres, body length and weight, moments of inertia, and centres of gravity have been altered. In addition, wheel diameters are likely to have been altered to suit home standards, while rail length and standards of track upkeep might also differ. Thus, frequencies and amplitudes of excitation will differ in addition to the natural frequencies of the vehicle system. It should therefore not come as a surprise that the originally "very good" bogies can be disappointing and that the attractive ideas incorporated in them are then declared as "no good for our conditions."

For example, the standard B.R. coach body is 64 ft. 6 in. long and weighs about 23 tons. The bogies are placed at 46 ft. 6 in. centres and the wheel diameter is 3 ft. 6 in. The standard Swiss coach body is 73 ft. 3 in. long and weighs 24·4 t., the bogies are at 51 ft. 6 in. centres and the wheel diameter is just under 3 ft. The moments of inertia I_z about the vertical axis through the centre of gravity are 668000 and 1285000 (16 ft. sec. ^{2}) respectively. With 12 in. long vertical swing links the natural frequency of body nosing will be 1·02 and 0·74 c.p.s., respectively, or, to put it differently, to achieve the low frequency of the Swiss coach the B.R. swing links should be 21 in. long.

The importance of the track is indicated by tests carried out under the auspices of the Office for Research & Experiment (O.R.E.) of the International Union of Railways (U.I.C.) on the riding of, among others, a standard British Railways coach. The performance of the vehicle, loosely coupled at the end of the test train, was ascertained in France between Melun and Montereau, in Germany between Bamberg and Lichtenfels, and in this country between Derby and Leicester. The results are summarised in the following table. The values are obtained by evaluating accelerometer records in terms of a method with which higher values signify better riding qualities.

Ride numbers (comfort riding factor) B.R. coach*

M.p.h.	Railway	Vertical	Lateral
66	B.R.	10	12
	D.B.	21·9	14·8
	S.N.C.F.	13·5	13·4
70	B.R.	8	10
	D.B.	9·2	26·3
	S.N.C.F.	21·2	23·5
88	B.R.	7	8
	D.B.	9	9·7
	S.N.C.F.	13	20·4

The original interpretation of the above numbers was as the number of hours a person could be subjected to the oscillations concerned without discomfort or fatigue. Considering that the longest journey in this country does not exceed about 8 hr., and accepting, for the sake of argument, the original interpretation of the significance of the comfort-riding factor, a ride-index value of 2·5 to 2·75 should be aimed at for new main-line coaches while 3 to 3·25 should be adequate for suburban stock.

The results of tests carried out on B.R. coaches running on bogies of widely-varying designs are plotted in Fig. 2. In all cases, identical coach bodies were used and riding qualities assessed for the vehicle running loosely coupled behind the train. The bogies included conventional and more recent designs, but wheelbase and wheel diameters were identical throughout. The fall of comfort factors with speed is significant, and it is of particular interest to note that the values decreased up to speeds of 50 to 60 m.p.h. The reasons for this pattern of behaviour are the subject of extensive investigations by O.R.E. Committee B. 52.

The results of more recent tests with a power car of a multiple-unit train are summarised below.

Ride-index value, M.U. power car

M.p.h.	Vertical	Lateral	Rail length ft.	Track
52	3·14	2·50	45	well used
56	2·68	1·93	60	recently laid
68	3·37	3·53	45	poor alignment
68	3·17	2·83	60	—

Here, too, the effect of track conditions on riding qualities is clearly indicated.

The above stresses the importance of the contribution which can be made by the permanent way engineer as well as the fact that good bogies, i.e., good riding vehicles are the outcome of consistent logical evolution based on an appreciation of certain fundamental considerations.

Effect of sound intensity

The increasing appreciation of the importance of noise reduction and improved heating and ventilation has brought these aspects of vehicle body design to the fore. It must be expected that appreciable strides will be made in this direction in an attempt to keep sound pressure level in passenger vehicles below 75 to 80 dB or 16 to 20 sones and that the thermal insulation will also benefit and, conversely,

*Another vehicle of the same type was used for tests in this country.

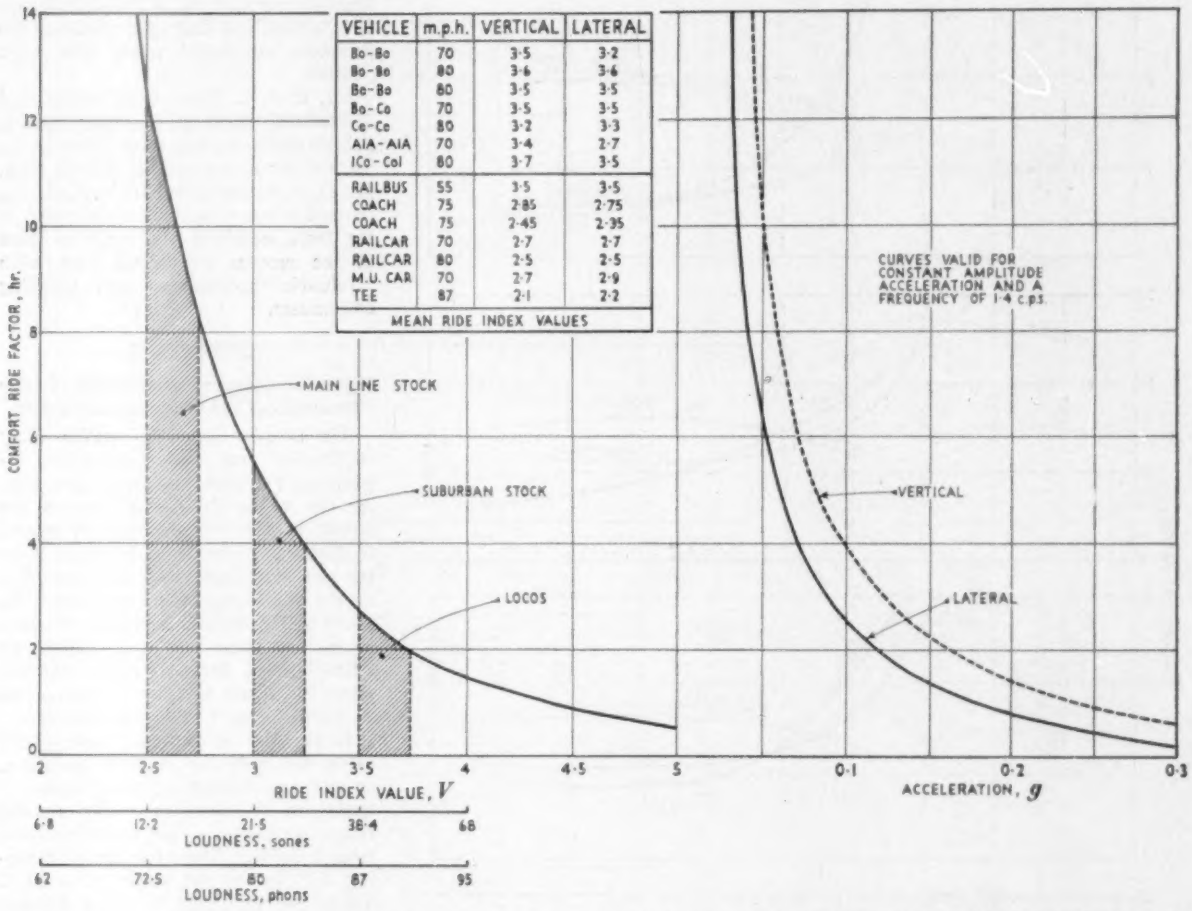


Fig. 1.—Relation between ride index and comfort-ride factors

improved thermal insulation will be of benefit as far as sound level is concerned.

The relation between sensitivity to sound intensity and sensitivity to the effect of oscillations has been considered by Postlethwaite some 20 years ago. Recent work by Sperling and Betzhold suggest that, for typical representative coach conditions, it should be possible to express the effect of sound intensities along similar lines to those adopted for oscillations (Fig. 1). Thus, a ride-index value of 3 is equivalent to a discomfort or fatigue time of 5·6 hr. and so is also a sound intensity of 21·5 sones. If both are encountered simultaneously then the total ride-index value will be obtained from:

$$V_t = \sqrt[10]{V_r^{10} + V_s^{10}}$$

In the above case:

$$V_t = \sqrt[10]{3^{10} + 3^{10}} = 3{\cdot}2,$$

so that the comfort-ride factor is reduced from 5·6 to 4·2 hr. Somewhat similar considerations apply to such variables as light intensity, temperatures, and humidities, all of which add up to the general feeling of "comfort." It will be appreciated that oscillations are but one aspect of a very complex picture, and that it will be necessary to pay far more attention to these as improvements take place in the other sectors. Personal observations suggest that passengers are likely to be more apprehensive of oscillations as loudness is reduced, so that simultaneous improvements should be the obvious aim.

Conclusions

In conclusion, it might be mentioned that, for main-line passenger vehicles, the aim of designers and development engineers should be bogies capable of ensuring ride-index values not exceeding 2·5. With coaches, the bogies should claim no more than 25-30 per cent of the total vehicle weight. The unsprung mass and moments of inertia about the Y- and Z-axes should be kept low. Low inertia about the Y-axis will be beneficial as far as pitching is concerned, while low inertia about the Z-axis will reduce the magnitudes of lateral impacts. These requirements call for light wheel sets and frames with minimum overall length. Preference should be given to traction bars as means of securing the body to the bogie. The design should be simple and capable of running for at least 150,000 miles between major overhauls. This requirement includes the dampers.

Adjustment and maintenance requirements must be kept to a minimum and it should be borne in mind that the attraction of an otherwise ingenious and possibly effective design is appreciably reduced if (to quote from some recent examples) the suspension system or the brake rigging are provided with some 40 grease points requiring fairly frequent attention. The quest for higher speeds and greater comfort demands the development of vehicles and their bogies suitable for operation at 100 m.p.h. or so, to the complete satisfaction of all concerned.

The days of repetitive empiricism are mainly in the past. They are giving way to the process of rational development which must be accepted as a matter of urgency if bogie design is to keep abreast of general engineering development. This process will not put up with the reliance on the magic powers of assorted recipes frequently jealously guarded and believed in by designers and salesmen alike.

Unnecessary calculations

According to Galileo Galilei, "Catastrophies stem from wrong calculations." It was the reluctance to indulge in what for a number of reasons appeared to be unnecessary calculations that was responsible for the poor performance of some

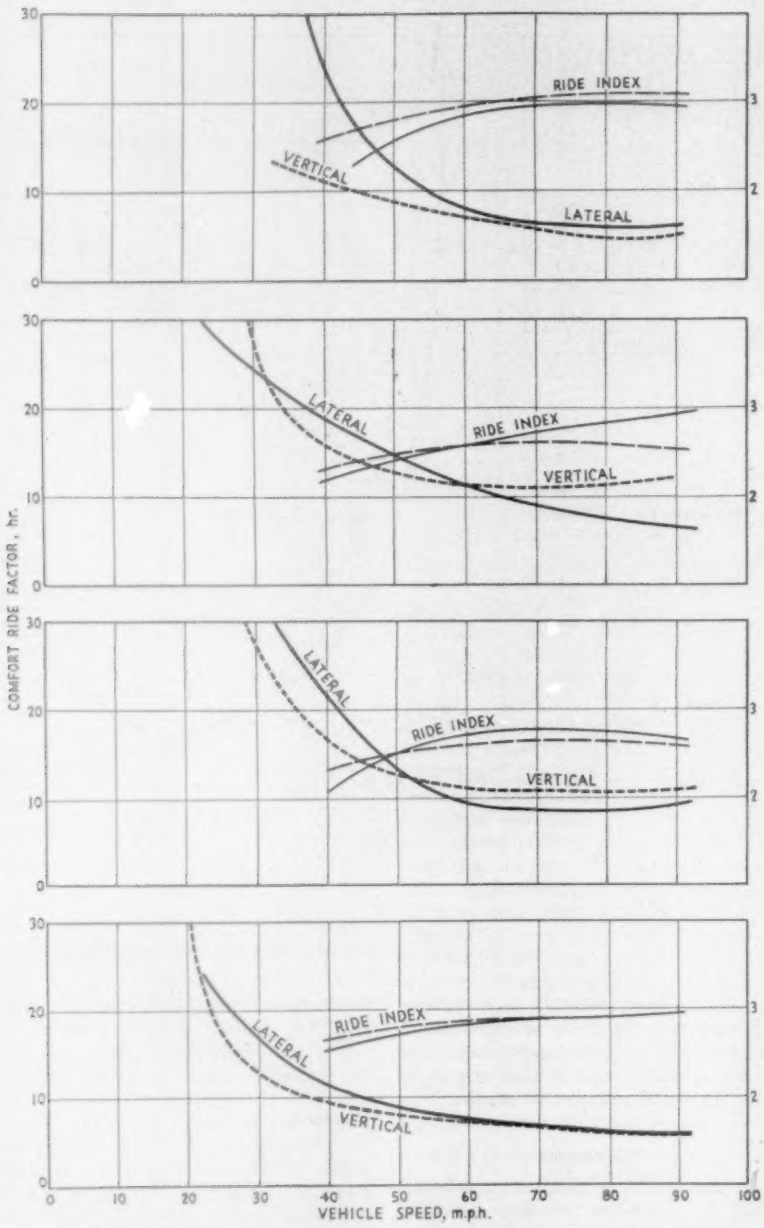


Fig. 2.—Ride index and comfort-ride factor values ascertained for B.R. standard coaches on four different bogie types

modern vehicles. Subsequent corrective measures based on a better appreciation of the causes of trouble and the steps undertaken to cure these (in retrospect appearing straightforward and eminently logical) have provoked management to ask, "Why has all this not been considered and done 20 years ago?" The criticism implicit in this question is well deserved and very much to the point. Why indeed? *Faire mieux si possible, ce qui est toujours possible.*

The development of bogie vehicles to a high state of perfection will not be possible without a clear appreciation of the relevant scientific principles. But it will be a very long time, if ever, before it will be possible to base everything here on purely scientific considerations. In the meantime, designers will take recourse to intuition. This is not to affirm the supremacy of instinct over intellect as far as vehicle design goes, but to draw attention to the fact that, in this sphere, art begins where calculation ends and that true vehicle designers will remain engineering artists if they are to be worthy of their name.

Acknowledgements

The consistent encouragement received by the author from Mr. J. F. Harrison and Mr. E. S. Cox, the Chief Mechanical Engineer and Assistant Chief Mechanical Engineer, respectively, of British Railways Central Staff and their appreciation of the problems concerned made this work possible.

Mr. W. J. A. Sykes, Chief Mechanical & Electrical Engineer, Southern Region, British Railways, was most encouraging, particularly during a rather difficult time. Mr. G. H. Batchelor and Mr. D. F. Alcock, both of whom have carried out most of the tests, obtained and analysed most of the records considered here, with invaluable thoroughness and unfailing enthusiasm.

APPENDIX I

Natural frequencies and velocities of some translational and rotational oscillations

The simpler forms of vehicle body oscillations are the Z-bouncing, β-pitching, Y-lateral, and γ-nosing modes. As far as purely formal aspects are concerned, the determinations of natural frequencies of the Z- and Y-motion on the one hand and the β- and γ-motion on the other hand follow identical lines. Some of the equations relating to these modes are given in Fig. 3. Here, the frequencies ω_1 and ω_2 [radians per sec] relate to Z- and Y-motion, while ω_3 and ω_4 relate to the β- and γ-oscillations.

In the case of systems 2 and 3, each mode has only one natural frequency, so that a common equation serves to determine ω_1 and ω_3. The natural frequency f in cycles per sec. is obtained from $f=\omega/2\pi$. The presence of damping will reduce the values of ω or f. Thus, the frequency ω^1 of a damped oscillation is $\omega^1=\omega\sqrt{1-D^2}$, where D is the damping factor. For D=0·1 and 0·3, $\omega^1=0{\cdot}955\omega$ and 0.954ω respectively. Even for D=0·5, $\omega^1=0{\cdot}865\,\omega$. Consistent units must be used throughout. Thus, if the weight W is in tons, then the mass m [t. sec.^{2} per ft.] and inertia I [t. ft. sec.^{2}], while spring stiffness c [t. per ft.] and the distance l, l_1, l_2, a and b must be in ft.

Resonance is encountered when excitation frequency/natural frequency ≈ 1 and under circumstances when the former is a full multiple or full fraction of the latter.

The amplitudes and velocities of bolster oscillations are of importance as far as loading gauge limitations and damper blow-off valve settings are concerned. The maximum lateral displacement values of bolster vis-a-vis bogie frame are plotted on the basis of extensive tests in Fig. 4. The maximum displacement velocity does not exceed about 40 ft./min. The vertical displacement varies between $d_d=0{\cdot}2\sqrt{d_2}$ and $d_d=0{\cdot}4\sqrt{d_2}$ depending on vehicle tendency to roll, $d_d=0{\cdot}3\sqrt{d_2}$ being a fair average with modern vehicles. Here, too, the maximum displacement velocity does not generally exceed 40 ft/min.

Continued on page 453

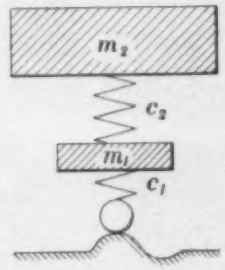
1

$$\omega_{1,2}=\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{c_2}{m_2}\right)\pm\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{c_2}{m_2}\right)^2-\frac{c_1c_2}{m_1m_2}}}$$

or :

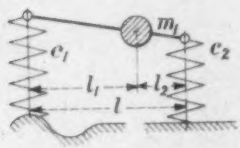
$$\omega_{1,2}=\sqrt{\left(\frac{\omega_I^2}{2}+\frac{\omega_{II}^2}{2}\right)\pm\sqrt{\left(\frac{\omega_I^2}{2}-\frac{\omega_{II}^2}{2}\right)^2+\frac{c_2^2}{m_1m_2}}}$$

$$\omega_I=\sqrt{\frac{c_1+c_2}{m_1}} \qquad \omega_{II}=\sqrt{\frac{c_2}{m_2}}$$



2

$$\omega_{1,2}=\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{c_1l_1^2+c_2l_2^2}{2I_1}\right)\pm\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{c_1l_1^2+c_2l_2^2}{2I_1}\right)^2-\frac{c_1c_2l^2}{m_1I_1}}}$$



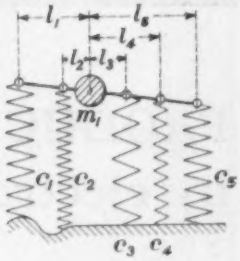
3

$$\omega_{1,3}=\sqrt{\left(\frac{\Sigma(cl^2)}{2I_1}+\frac{\Sigma c}{2m_1}\right)\pm\sqrt{\left(\frac{\Sigma(cl^2)}{2I_1}+\frac{\Sigma c}{2m_1}\right)^2-\frac{\Sigma c\Sigma(cl^2)-(\Sigma(cl))^2}{mI_1}}}$$

or :

$$\omega_{1,3}=\sqrt{\left(\frac{\omega_I^2}{2}+\frac{\omega_m^2}{2}\right)\pm\sqrt{\left(\frac{\omega_I^2}{2}-\frac{\omega_m^2}{2}\right)^2+\frac{(\Sigma(cl))^2}{mI_1}}}$$

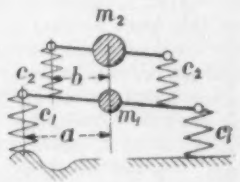
$$\omega_m=\sqrt{\frac{\Sigma c}{m_1}} \qquad \omega_I=\sqrt{\frac{\Sigma(cl^2)}{I_1}}$$



4

$$\omega_{1,2}=\sqrt{\left(\frac{c_1+c_2}{m_1}+\frac{c_2}{m_2}\right)\pm\sqrt{\left(\frac{c_1+c_2}{m_1}+\frac{c_2}{m_2}\right)^2-\frac{4c_1c_2}{m_1m_2}}}$$

$$\omega_{3,4}=\sqrt{\left(\frac{c_1a^2+c_2b^2}{I_1}+\frac{c_2b^2}{I_2}\right)\pm\sqrt{\left(\frac{c_1a^2+c_2b^2}{I_1}+\frac{c_2b^2}{I_2}\right)^2-\frac{4c_1c_2a^2b^2}{I_1I_2}}}$$

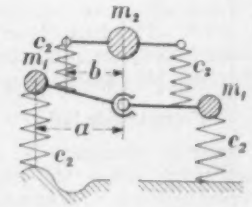


5

$$\omega_{1,2}=\sqrt{\left(\frac{c_1+ec_2}{2m_1}+\frac{e^2c_2}{m_2}\right)\pm\sqrt{\left(\frac{c_1+ec_2}{2m_1}+\frac{e^2c_2}{m_2}\right)^2-\frac{2e^2c_1c_2}{m_1m_2}}}$$

$$\omega_{3,4}=\sqrt{\left(\frac{c_1+e^2c_2}{2m_1}+\frac{a^2e^2c_2}{I_2}\right)\pm\sqrt{\left(\frac{c_1+e^2c_2}{2m_1}+\frac{a^2e^2c_2}{I_2}\right)^2-\frac{2a^2e^2c_1}{m_1I_2}}}$$

$$e=b/a$$



6

$$\omega_{1,2}=\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{c_2}{m_2}\right)\pm\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{c_2}{m_2}\right)^2-\frac{2c_1c_2}{m_1m_2}}}$$

$$\omega_{3,4}=\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{a^2c_2}{I_2}\right)\pm\sqrt{\left(\frac{c_1+c_2}{2m_1}+\frac{a^2c_2}{I_2}\right)^2-\frac{2a^2c_1c_2}{m_1I_2}}}$$

$$f=\omega/2\pi \text{ [cycles per sec.]}$$

ω_1 and ω_2 are the natural frequencies of bouncing [radians/sec.]
ω_3 and ω_4 are the natural frequencies of pitching [radians/sec.]
m is the mass, I is the moment of inertia.

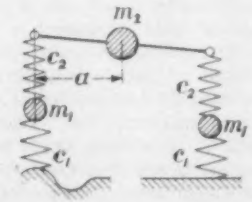
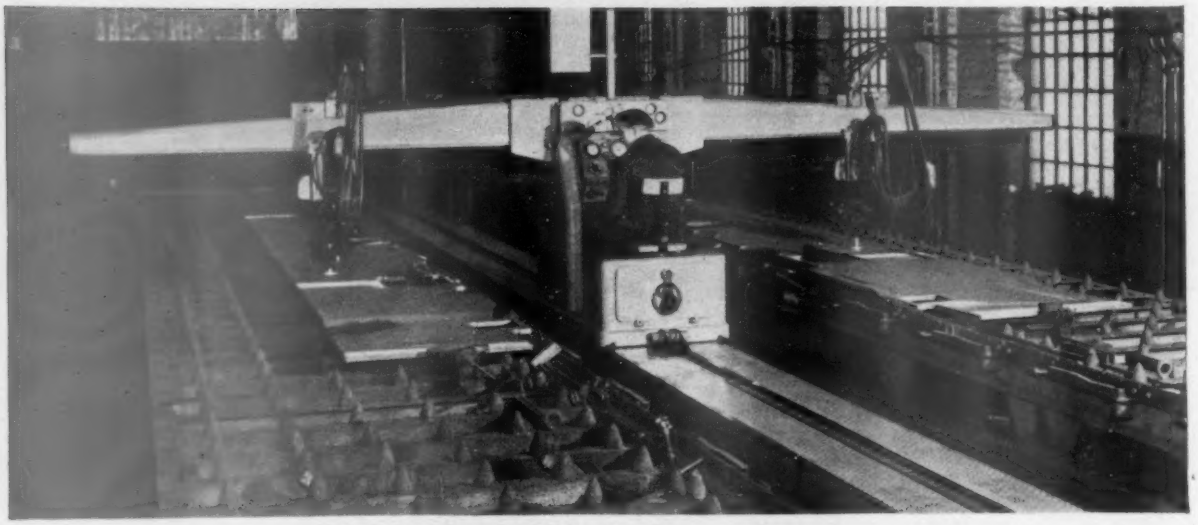


Fig. 3.—Natural frequencies of typical suspension configurations



Automatic flame-cutting of components for diesel locomotives

PRODUCTION FLAME-CUTTING by electronic control

Use of modern techniques for welded-steel assemblies at Crewe

STEEL-PLATE fabrications form a considerable part of the structure of modern diesel and electric locomotives, and the volume of this work handled at Crewe locomotive works of British Railways has necessitated new lay-outs for well-planned flow production and the use of the most up-to-date equipment available.

The profile-cutting of plates is carried out on a Schichau-Monopol flame-cutting machine. This is a fully-automatic photo-electrically-controlled double-headed machine which will cut any profile in one setting on two plates up to 40 ft. x 6 ft. The shape of the profile cut is determined by the image contained on a photographic glass plate negative.

Central guide-bed

The machine comprises a central guide-bed along which the travelling control console moves. Mounted on the console at right angles to the bed are two outriggers carrying the oxy-acetylene cutting heads. The plates to be cut are laid on worktables at each side of the bed, each cutting head producing a mirror image of the profiling on the opposite side.

Movement of the console along the bed is effected by a motor-driven revolving nut on a fixed leadscrew. Transverse movement of the cutting heads is by a revolving leadscrew contained in each of the outrigger arms, and by combining the longitudinal and transverse movements any profile can be produced.

The Monopol machine uses a 15 x 6 cm. negative, carrying a drawing to a scale of 1 : 100 of the cut plate. Mounted in a carrier, the negative is placed in the console and the operator, seated on the machine, aligns the starting point on the negative against a pointer. The negative is then moved by an electric motor at 1/100th of the cutting speed required at the heads past a photo-electric scanning head. The signals of the scanner, working through a component analyser and selsyn motor, automatically control the cutting head movements to follow the profile on the negative.

Voltage stabiliser

To ensure that the light intensity operating the photo-electric cell remains constant, a voltage stabiliser is incorporated, this keeping the voltage constant to within ± one per cent.

An automatic height control is fitted to the cutting heads. This, which ensures that the correct distance between burners and plate surface is accurately maintained, is operated by an electro-mechanical feeler device which scans the plate surface. In the event of the burner meeting an obstruction, the cutter automatically moves upward.

Cutting speeds range from 6 in. to 30 in. per min., according to plate thickness. There is also a fast longitudinal travel of 240 in. per min. and a cross traverse of 60 in. per min. for tool-positioning.

Because of the high ratio of magnification between negative and actual size of finished plate, a very accurate negative must be used. A master drawing is made 1/10th full size, in which all lines are kept to an even density and prescribed thickness, on which the starting and run-out' points are clearly marked. This drawing is photographed with a special camera to produce the working negative, the scale of which is 1/10th of the master drawing.

Minimum of scrap

It is claimed that it is much quicker to lay out the plate on the drawing board instead of marking it out on the shop floor, and that scrap is reduced to a minimum. The points for the start and finish of the profiling cuts and the position of the bridge pieces are selected to control plate expansion and distortion to within required limits.

After flame-cutting, the plates are transferred to the fabricating shop for building into the main sub-assemblies of the locomotive structure. This shop, previously the boiler repair shop, has been laid out to obtain a smooth and progressive work flow of the various types of assemblies. Considerable emphasis

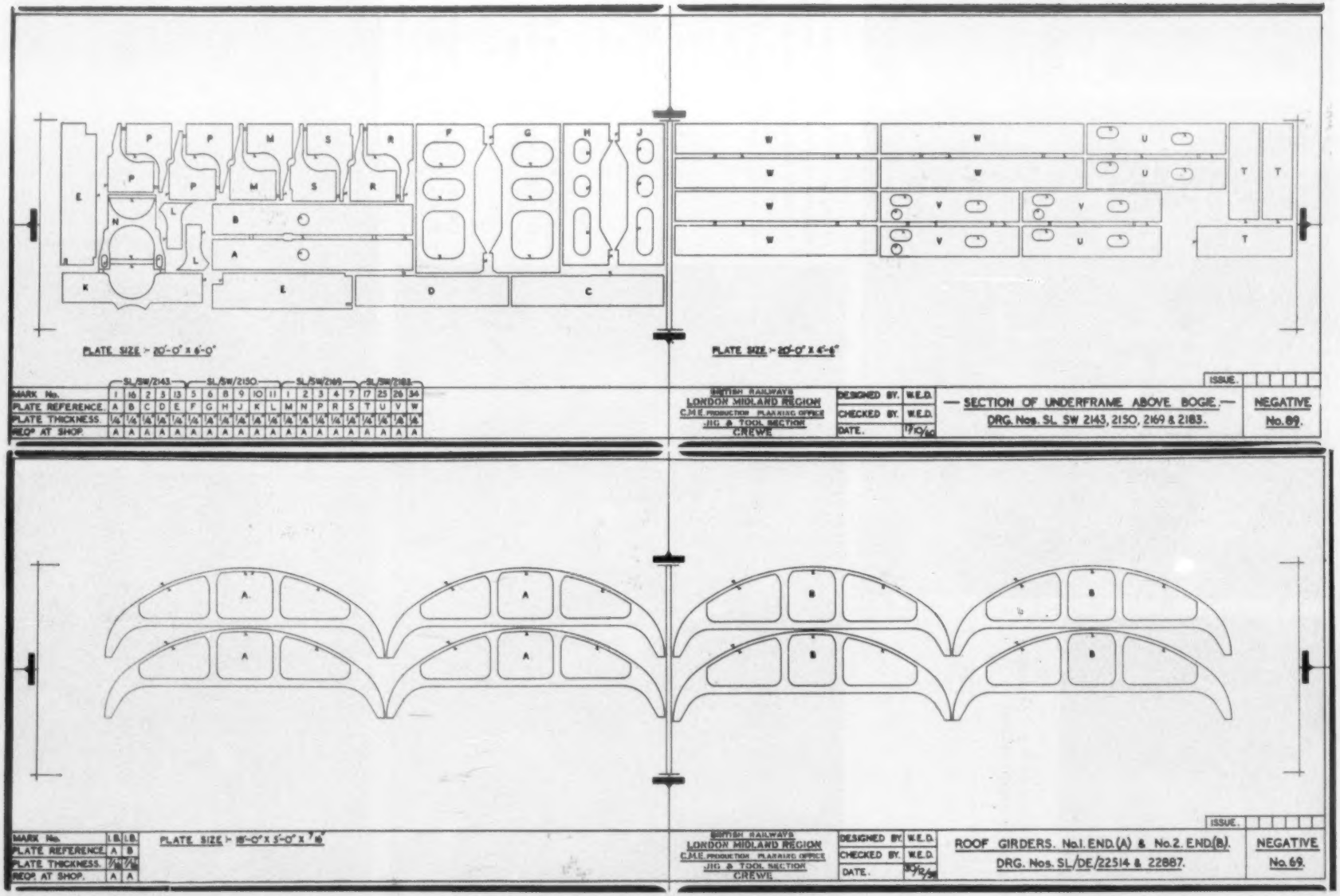
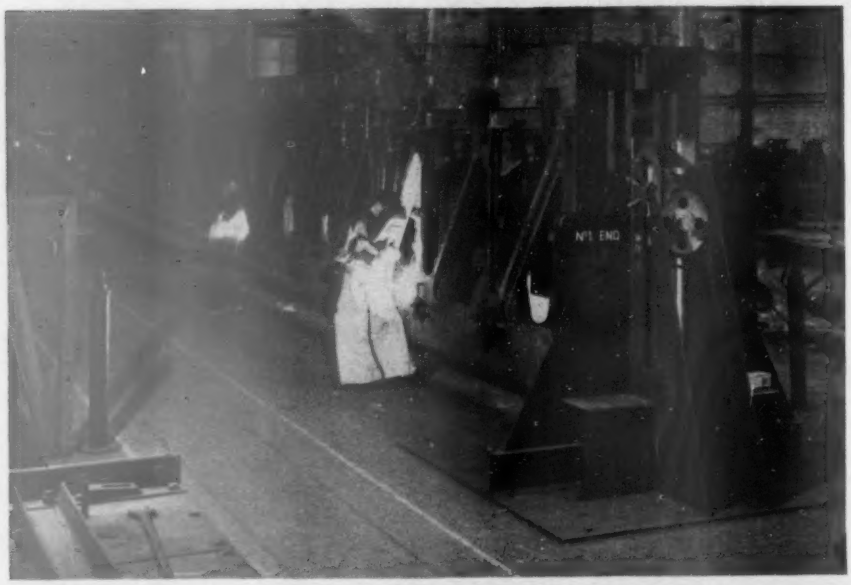


PLATE SIZE :- 20'-0" x 6'-0"
PLATE SIZE :- 20'-0" x 6'-6"
MARK No. | SL/SW/2143: 1 16 2 3 13 5 6 8 9 10 11 | SL/SW/2150: 1 2 3 4 7 | SL/SW/2169: 17 25 26 36 | SL/SW/2183
PLATE REFERENCE: A B C D E F G H J K L M N P R S T U V W
PLATE THICKNESS: ⅛" throughout
RECD AT SHOP: A throughout
BRITISH RAILWAYS
LONDON MIDLAND REGION
C.M.E. PRODUCTION PLANNING OFFICE
JIG & TOOL SECTION
CREWE
DESIGNED BY. W.E.D.
CHECKED BY. W.E.D.
DATE. 17/10/60
ISSUE.
— SECTION OF UNDERFRAME ABOVE BOGIE. —
DRG. Nos. SL. SW 2143, 2150, 2169 & 2183.
NEGATIVE No. 89.
PLATE SIZE :- 18'-0" x 5'-0" x 7/16"
MARK No. | 1 B | 1 B
PLATE REFERENCE: A B
PLATE THICKNESS: 7/16 7/16
RECD AT SHOP: A A
BRITISH RAILWAYS
LONDON MIDLAND REGION
C.M.E. PRODUCTION PLANNING OFFICE
JIG & TOOL SECTION
CREWE
DESIGNED BY. W.E.D.
CHECKED BY. W.E.D.
DATE. 30/12/36
ISSUE.
ROOF GIRDERS. No.1. END.(A) & No.2. END.(B).
DRG. Nos. SL/DE/22514 & 22887.
NEGATIVE No. 69.

Negatives used in photo-electric scanning head of Schichau-Monopol machine

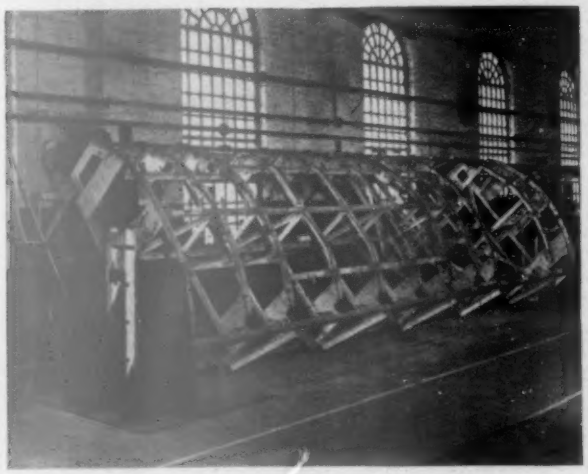
Console of Schichau-Monopol electronically-controlled profiling machine

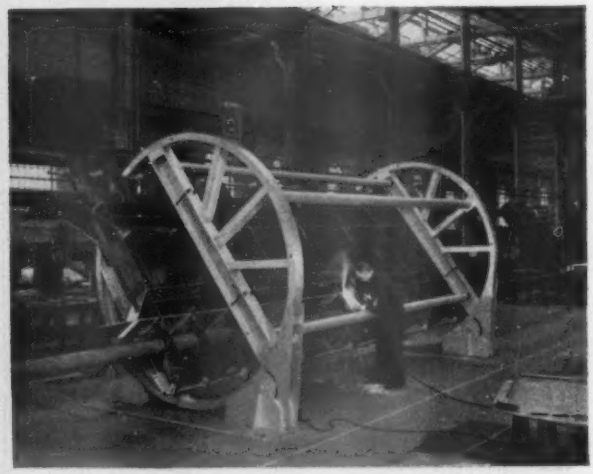


(Above and left): rotatable welding jigs for Type 4 diesel-electric underframe and side truss

(Below, left): light welding jig for roof sections, fabricated from rolled angle sections

(Below): rotating manipulator for Swindon Type 4 diesel-hydraulic underframe





is given to safety precautions, which include clear, wide gangways, enclosed compounds for bench welding, and compounds for gas-cylinder storage. Wheeled trolleys and portable stands with cushioning mats ensure safe handling and storage of cylinders in the vertical position, and all cylinders and equipment are colour-coded. All welders are trained in the works welding school.

Before welding, the flame-cut plates are levelled and machined. Bending and flanging are carried out on hydraulic flanging presses. Welding fixtures are used for building up sub-assemblies, and datum points on these are machined to provide accurate location in the structure assembly jigs.

Large assembly jigs are used for the main underframe, roof structure, bulkheads, and bodyside assemblies. To permit downhand welding, the complete jig is arranged to rotate in a trunnion mounting bracket at each end. The construction and weight of each jig is proportioned to the weight of the respective assemblies. For the Type "4" diesel-electric underframes and side trusses, jigs are fabricated as deep box-sections with a large number of clamping locations to minimise welding distortion and balanced for easy turning. The lightweight roof-section jigs are fabricated in rolled angle-sections and plate. A manipulator of unique form is used for welding the lightweight underframe of the Swindon-designed Type "4" diesel-hydraulic locomotives.

Two large-diameter flanged rings, connected together by spacing tubes, are arranged to revolve on rollers carried in floor-mounted brackets. The underframe sub-assemblies are threaded over the two tubular members of the frame and clamped to a chordal member inside each ring. The sub-assemblies are then welded together and to the tubular members. By rotating the jig, work can be readily positioned to permit downhand welding at all points.

Design and development of bogies—VI

(*Concluded from page* 448)

APPENDIX II

Friction damping

Use is made of friction forces to provide lateral damping at the swing links of a number of modern bogie designs with not always consistent results. The transmissibility provided by dry-friction damping is largely controlled by the factor

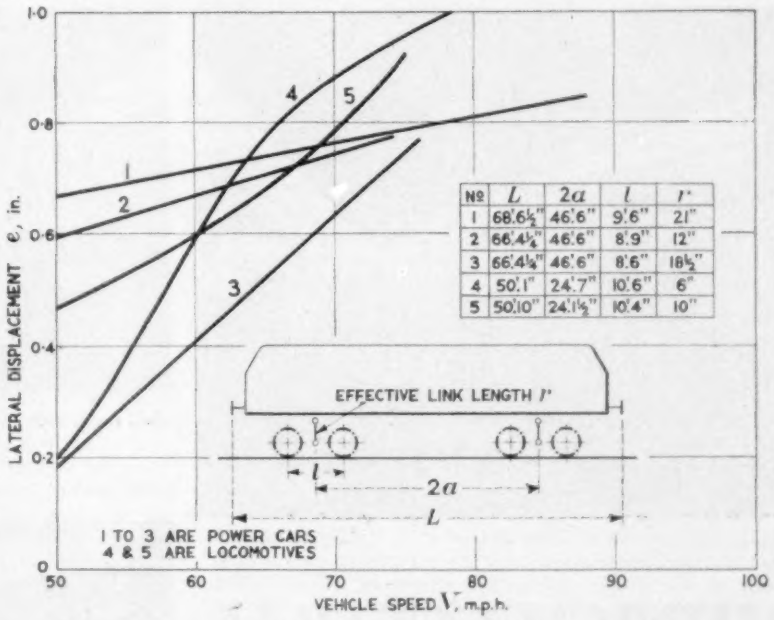
$$\delta = P/ca_0\ [—]$$

where P [t] is the friction force, c [t per in.] the spring or swing link rate, and a_0[in.] the half amplitude of the exciting oscillation. The important point is that the transmissibility remains finite at resonance as long as $\delta > \pi/4$, but it becomes (theoretically) infinite as soon as $\delta < \pi/4$. Because of this, δ should not be less than 0·9. Conversely, the critical amplitude at resonance should not exceed the value of $a_c = 4\ P/\pi c = 1{\cdot}275\ P/c$ [in.].

As an example, consider the data of the centre diagram of Fig. 3 (part IV of this article published on August 25). Here, P = 0·75t, c = 2·5t per in. while the amplitude of excitation is limited to the wheel flange to rail clearance. On poor track, a_0 can be 0·25 in. Consequently, $\delta = 0{\cdot}75/2{\cdot}5 \times 0{\cdot}25 = 1{\cdot}2$.

For the right hand diagram, of Fig. 3, P is approximately 0·5 tons while c = 1·9 t. per in., so that, for a_0 = 0·25 in., $\delta = 0{\cdot}5/1{\cdot}9 \times 0{\cdot}25 = 1{\cdot}05$, which should be satisfactory—as substantiated by road tests.

The five previous parts of this article appeared in this year's issues of *The Railway Gazette* as follow:—
Part i, March 17; Part ii, April 21; Part iii, May 12; Part iv, August 25; Part v, September 29.



№	L	2a	l	l'
1	68'6½"	46'6"	9'6"	21"
2	66'4¼"	46'6"	8'9"	12"
3	66'4⅛"	46'6"	8'6"	18½"
4	50'1"	24'7"	10'6"	6"
5	50'10"	24'1½"	10'4"	10"

Fig. 4.—Maximum lateral displacement amplitudes between body and bogie

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Some of the data contained in this series of articles have been drawn freely from a considerable amount of information published in this country, France, Germany, and Russia. Acknowledgment of sources of information has been made by reference to the bibliography which should prove of assistance to readers seeking more detail on specific questions.

Papers by Lehr, Marquard, Mauzin, Sperling, Van Eldik Thieme, and Zweifel are particularly valuable as far as vehicle oscillations are concerned and these and others have been quoted previously. Fundamental considerations are dealt with at length in specialised texts and some of the more useful ones are mentioned below.

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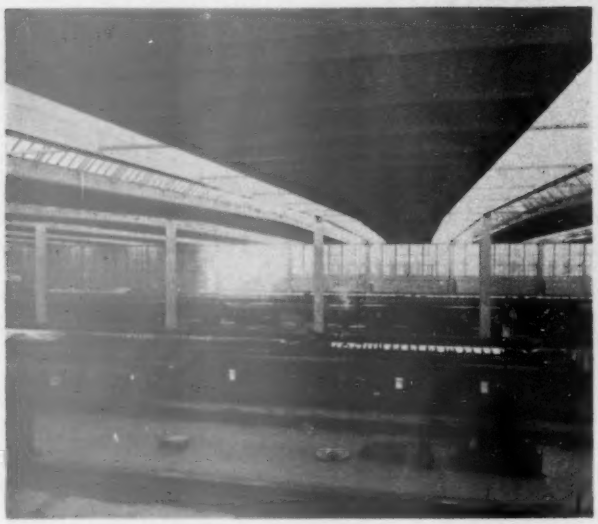
MUNICH CENTRAL STATION

Eastern frontage

Munich's Central Station is the most modern of its kind in the German Federal Republic. The eastern frontage, which is 550 ft. long, is built symmetrically with a glass wall and projecting concrete roof in the centre. On the fourth and fifth floors is a car park for over 200 vehicles.

Platform hall



Main concourse

Ticket counter

Booking hall

Baggage conveyor belt

ELECTRIC RAILWAY TRACTION SECTION

Clearing the air

APART from providing much new and valuable information, the paper presented to the Brazilian Federal Railways Conference last month by Mr. J. A. Broughall, Assistant Chief Electrical Engineer, British Transport Commission, has disposed of some myths which were tending to grow around the story of 50-cycle electrification in Great Britain. A summary of his paper follows this editorial. In particular, his unqualified recommendation of the system when 25kV. can be used throughout abandons the attempt to find some peculiar virtue in the adoption of two voltages, as has been forced upon British Railways. Probably no engineer has ever regarded this otherwise than as a nuisance, but there have been some well-meaning endeavours to suggest that it is an arrangement which others might wish to emulate, and that our own troubles in this connection would smooth the way elsewhere later. Some sought to find comfort in the fact that Brigadier Langley's first interim report on the Glasgow transformer accidents included the comment that no evidence had been found to link them with the dual-voltage system. Later experience brought evidence that operations connected with voltage changeover can produce serious effects on electrical equipment in trains. Referring specifically to transformers, Mr. Broughall says "it must remain open to question, pending the issue o Brigadier Langley's final report, to what extent the failures that have occurred on secondary windings of the helical type are due to the use of that type of winding and how far they are due to other circumstances, including the transition from one voltage to another." Indeed, far from attempting to find merits in the dual-voltage system, Mr. Broughall comments that the Glasgow line is the one where transition from 25 to 6·25kV. is most frequent, and elsewhere in his paper reports with satisfaction that experiments with reducing clearances from the contact wire are expected to lessen materially the number of occasions on which it will be necessary to have recourse to 6·25kV. British Railways are shown clearly in the paper to constitute a special and awkward case in matters of a.c. electrification for, apart from clearance problems, the frequency of overbridges and complex junctions prevents the realisation in this country of savings on the same scale as others may expect from the lighter contact system. Furthermore, the cost of booster transformers and return conductors which has had to be borne here would not occur where a railway and a telecommunication system can be developed simultaneously.

Such thoughts must raise the question whether the choice of high-voltage a.c. was the correct one for British Railways. It has been said many times that this system offers most scope for development, and Mr. Broughall supports this with examples of work coming to fruition here. In the field of overhead equipment, resin-bonded, glass-fibre insulators, and section insulators of the same material, have reached the stage where fulfilment of their promise can be foreseen. For over a year there has not been a single case of failure of a P.T.F.E.-protected glass-fibre insulator in the contact wire and elsewhere at 25kV., nor has it been necessary under the most polluted climatic conditions to carry out any cleaning or other maintenance. Another example is in motive power, for the first British Railways electric locomotive using static devices for control of voltage to the traction motors will be ready in a few months. The essential feature of the scheme is stepless transition between transformer tappings by controlling the current in the 10W.-power windings of two transductors. This arrangement will allow an increase of 10 per cent or more in effective adhesion, simplify the electrical equipment in certain respects, and have a good effect on efficiency and power factor. With regard to existing equipment, Mr. Broughall shows that the record of reliability is far brighter than might be supposed after the troubles of late 1960. There has been no failure of transformers in 112 motor coach equipments which have been in service since 1959. Three hundred locomotive motors have now run an aggregate of over 300,000km. without a single failure, and a series of over 450 motor coach motors by the same manufacturer has already aggregated over 2·5 million km. without a fault. Experience of over a year with motor coaches equipped with germanium rectifiers has led to an order for semiconductor rectifiers for a series of 40 locomotives, the first four of which have run 8,000km. without difficulty. The aim today is toward greater simplicity of equipment. This eminently practical objective will command interest wherever electrification of steam lines or the conversion of d.c. routes to a.c. is being considered.

Training in machine theory

OFTEN, the realisation that the various forms of electrical machine have a common theoretical basis does not come to a student until the later stages of his training. This is a consequence of traditional methods of instruction which deal with each machine in turn, so that progression from the d.c. to the a.c. motor, for example, is regarded as a step up rather than the recognitition of familiar features in a different guise. Of late, there has been a new trend in the methods of teaching electro-mechanical energy conversion, which regards each machine as a specialised application of a single basic device. To assist instruction on these lines, a generalised machine set suitable for technical training colleges has been introduced by Associated Electrical Industries, Limited. It consists of a generalised machine which can be connected for operation as any one of the conventional types of electrical machine, and which is coupled to a d.c. machine on a common bedplate for motoring and loading. The stator winding is in sections which may be connected in series, series-parallel, or parallel, and the rotor has a three-phase lap winding and a wave-wound commutator winding, with one dead coil, connected to a 95-segment commutator with six tappings, enabling the effects of various winding pitches to be studied. Possibilities of experiment include the use of the stator winding as a shunt or series winding, a compensating winding, an induction machine secondary winding, a synchronous machine winding, or a Schrage motor secondary winding, and so on. This flexibility is a useful adjunct to new methods of teaching. These place greater emphasis on fundamental principles, and will provide students with a broad view of their subject. In this way they will more rapidly grasp the new aspects of electrical technology which they are increasingly likely to meet in the course of their professional careers. Hitherto, training in railway traction has followed traditional lines for the most part, but there are signs that those who are making a career in this field must be equipped with a breadth of outlook such as was rarely required of their predecessors.

INDUSTRIAL-FREQUENCY ELECTRIFICATION in Great Britain

Summary of a paper read by Mr. J. A. Broughall, Assistant Chief Electrical Engineer, British Transport Commission, to the Brazilian Railways Federal Conference in Rio de Janeiro

DURING the Brazilian Railways Federal Conference in Rio de Janeiro from September 11 to 19, delegates heard a paper by Mr. J. A. Broughall, Assistant Chief Electrical Engineer, British Transport Commission, entitled "Progress of electrification at industrial frequency in Great Britain." Translations had been provided of eight of the papers presented to the British Railways Electrification Conference in London in 1960, and Mr. Broughall covered briefly the major events up to that time, but the greater part of his contribution was concerned with features which have since proved to be important, and with some later developments which experience has shown to be significant for the future of high-voltage single-phase electrification at industrial frequency.

Power supply in Britain

British Railways have been fortunate, said Mr. Broughall, in having a good power supply system which had not been adversely affected either by the unbalance due to single-phase loads or to the effects of harmonics arising from the use of rectifiers to supply d.c. traction motors. The traction load (½-hr. maximum demand) nowhere exceeded 1·5 per cent of the short-circuit power available at a supply point. Both types of circuit breaker in use, namely, minimum oil and bulk oil, had behaved excellently. So had the impedance protection system, but there had been a few occasions when quicker back-up would have been useful and modifications were being made to achieve this. For example, it had been decided to make greater use of the spare pilots available in the railway telecommunication cables to provide inter-tripping between the ends of feeders close to supply points with high fault levels.

It was satisfactory also to record that the voice-frequency supervisory equipment for the control of circuit breakers had functioned perfectly. This equipment was of two makes and certain compromises were needed to provide compatibility of one with the other: transistors had been extensively used in both systems and had been one factor which permitted the use of mimic diagrams formed of plates 25-mm. square to permit individual control from a diagram which could readily be adjusted for later additions to the lines to be electrified.

With regard to overhead equipment, the opinion that the normal U.I.C. clearance, 270 mm. static and 220 mm. passing, would be satisfactory, in spite of the British climate and a considerable continuing steam-hauled traffic, had been vindicated. In fact, experiments had been made and are continuing which were expected to prove that the clearance for 25kV could be reduced, when desirable on grounds of economy, to 203mm. static and 152mm. passing. This would materially reduce the occasions on which it would be necessary to have recourse to 6·25 kV. It would thus simplify the train equipments and reduce the cost of power supply. The opinion that 101mm. static clearance and 76mm. passing clearance, normal for 1,500-V. d.c. traction, would be adequate for 6·25 kV. had also been proved correct. Some trouble had been experienced with lines being earthed by birds and auxiliary insulation is now being used when possible to reduce this nuisance.

Insulator developments

The light, well galvanised structures, mass-produced by the welding of rod and light angles, had been successful, as also the use of porcelain insulators subject to bending stresses. Greater importance was attached to the development of resin-bonded glass-fibre insulators and to the use of this material for section insulators. To be successful in the latter capacity, they must be fully resistant to the direct abrasion of the pantograph and capable of standing the imposed electro - mechanical stresses and occasional power arcs in the same way as the contact wire which they displace. After six or seven years of intensive development, it could be said that the present designs indicate that these objectives are now capable of realisation. It was extremely encouraging to record that, for over a year in the contact line and elsewhere at 25 kV., there had not been a single case of failure of a P.T.F.E.-protected glass-fibre insulator from any cause, nor had it been necessary even under the most polluted climatic conditions to carry out any cleaning or other maintenance. Such savings and other advantages would more than compensate for some present additional cost.

At isolated places, in the initial stages, there were cases of pantograph bounce and poor current collection. Corrective measures had been applied which had virtually eliminated the hard spots on the overhead equipment in question, which was of the fixed, i.e., not weight-tensioned, type. In particular, the performance of graphite collectors had been very satisfactory. They promised to reduce maintenance and prolong the life of the cadmium copper contact wire.

Rolling-stock equipment

The use of d.c. series motors was standardised for both locomotives and motor coach trains. The 300 motors of 800 h.p. (B.S. rating) for three series of locomotives had run an aggregate of over 300,000 km. without a single motor failure: their commutation in service was as good as their test bed performance described. Brush life, in spite of a 30 per cent ripple, was of the order of 5,000 km. per millimetre of wear. These machines had been used with an Alsthom flexible drive. Excellent performance without a single motor failure had been obtained after an aggregate of over 2·5 million km. from another series of over 450 motors of 210 h.p. by the same manufacturer. These are axle-hung motors on motor coach trains, with a similar value of ripple.

Bearing in mind that contracts were placed in 1957, it was not surprising that most of the fleet used mercury-arc rectifiers. With one possible exception, these had given very satisfactory service although there were initial difficulties with the shutters forming part of the ventilation arrangements of another series. What is considered more important is the satisfactory performance of semi-conductor rectifiers; 45 motor coach equipments with germanium rectifiers were ordered in 1957 and many had been in service for over a year. So well did they perform that the 40 locomotives now building at Doncaster Works were being equipped, some with germanium and some with silicon rectifiers instead of mercury-arc rectifiers originally ordered. Eight of these had been delivered and the four that had been commissioned had run 8,000 km. without difficulty. Semi-conductor rectifiers took up less room to

such an extent as to permit the installation of a substantial (1,000-kW.) rheostatic brake within the weight and dimensions previously needed for mercury-arc rectifiers. Rolling-stock of all kinds powered with semi-conductor rectifiers had now run nearly five million km. without failure of the rectifier as such. Included in this total were four types of equipment, including silicon rectifiers, in none of which had it been found necessary to use a short-circuiting switch to protect the rectifier, due, it was believed, to a cautious policy in grading the cells and to choice of the right number of cells of suitable quality—an essential requirement in using semi-conductor devices.

Voltage control to motors

In a few months British Railways would have its first locomotive using static devices for control of voltage to the traction motors. The arrangement, which had already completed its works test satisfactorily, comprised silicon rectifiers instead of ignitrons, a transductor tap-changing scheme, and rheostatic braking. The essential feature of this scheme was that two adjacent transformer tappings were connected to the load simultaneously, each connection having a self-excited transductor in series. By controlling the current in the low-power control windings of the transductor connected to the higher of the two taps, the load current could be steadily transferred from the lower to the higher tap, or *vice versa*, and, therefore, the traction motor voltage could be raised or lowered smoothly from zero to full value.

This type of control scheme had great advantages. First, the smooth control of traction-motor current allowed an effective increase in adhesion of 10 per cent or more, so that a 73-ton locomotive could start the same train as an 80-ton locomotive with old-fashioned tap-changing. Secondly, the characteristics of the locomotive, with speed as the ordinate and tractive effort as the abscissa, were very much flatter than with ordinary tap changing. This again favoured better adhesion, because the speed of a slipping wheel would be considerably reduced. Thirdly, only the magnetising current of the transductors, which was less than 10 A., had to be interrupted by the power contactors; therefore, arc chutes, blow-out coils, high-speed mechanisms, surges, ionisation, and so on were eliminated. Fourthly, since the scheme was essentially one of low-voltage control, it had the inherent advantages of the best possible efficiency and power factor. Fifthly, the good performance in energy consumption was maintained unchanged for both the 6·25-kV. and 25-kV. overhead line voltages. With a 25-kV. tap changer, the energy requirements for a given performance were worse on the 6·25-kV. than on the 25-kV. overhead line.

While there had been exceptions to the general experience that a transformer was a completely reliable apparatus, there had not been any failures of the four types used on locomotives. There had been no failure of the transformers used on 112 motor coach equipments which had seen the longest and most arduous service in the Eastern Region, including about 25,000 automatic transitions from 25 to 6·25-kV. and *vice versa*, and including one occasion on which, because of error, 25-kV. was accidentally applied to 6·25-kV. The rolling-stock incorporating these transformers had worked over 11 million km. without a transformer failure.

There had not been any failures of transformers using what was known as the interleaved pancake winding. The major series of failures were those on the Glasgow line where transition from 25 to 6.25 kV. was the most frequent. It must remain open to question, pending the issue of Brigadier Langley's final report, to what extent the failures that had occurred on secondary windings of the helical type were due to the use of that type of winding and how far they were due to other circumstances, including the transition from one voltage to the other. It was certain that our experiences had led to a great increase in knowledge of the effect of short circuits on transformer windings, which would be of value to all when it was possible to narrate it. For the moment it must suffice to say that our experience showed at least one way of ensuring that transformers were trouble-free.

Control gear

All the motor coach trains had speed control by tap changing on the secondary winding.

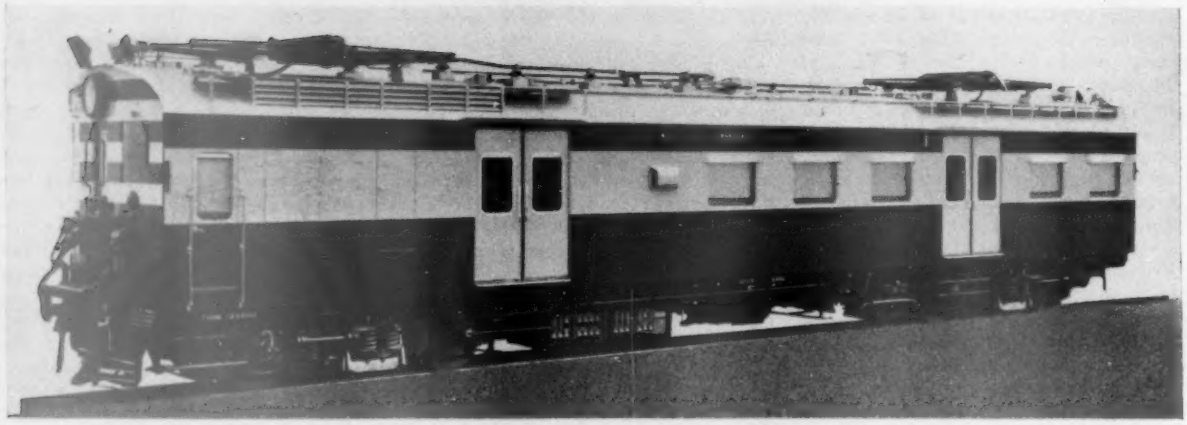
Two of the five types of locomotive had speed control by tapping the primary winding and three by tapping the secondary. All were now giving satisfactory service. Some had required modification; in particular, it had been necessary to locate and eliminate stray fields in one l.t. tap changer and to redesign the contact system of a novel form of h.t. tap changer. Several prototypes were under test, including one using a contact sliding up and down the secondary. The possibility of using a variation of the voltage regulator to give notchless control had been investigated and rejected on the score of weight and bad power factor.

The intention expressed in the specification for these equipments was to reduce protective devices to the minimum, but this objective had not yet been realised. While some equipments were now considered to be over-elaborate, others had needed additional apparatus. The motors of one fleet of motor coaches suffered considerably from over-voltages, particularly when working in the 6·25-kV. areas. These were due to transients developed by the rapid cut-off of the air blast circuit breaker with which every locomotive and motor coach was equipped. Most of this trouble disappeared as soon as a good earth was provided near the motors. The remainder would doubtless cease when capacity/resistor circuits have been fitted to absorb the over-voltages in question. One of the Commission's firms of consulting engineers, Messrs. Merz & McLellan, which had been assisting in the solution of this problem, had patented a special form of resistance switching. This showed promise of reducing these over-voltages from values lying between 50 and 70kV. to values of the order of 30kV. by a simple modification of the existing circuit-breakers. The effects of these over-voltages were relatively more severe when the 6·25-kV. circuit was in use, and no trouble had occurred on 25-kV. operation. Capacity resistance networks were essential where semi-conductor rectifiers were used.

Outlook for the system

Mr. Broughall said in conclusion that British Railways had saved the cost of an expensive high-voltage cable system linking one substation to its neighbours. This saving and the concomitant saving in switchgear in the case of its main-line electrification was of the order of 60 per cent of the total cost of the power supply equipment. The case was probably a special one in connection with the remainder of the fixed equipment on account of the number and frequency of bridges and complex junctions. On simpler lines there was a very real saving by using the lighter contact system. British Railways had been obliged to use booster transformers and/or return conductors to avoid interference with a dense and often outmoded telecommunication system, the total cost of this being of the order of 5 per cent of the cost of fixed equipment. If one could develop the railway system and the telecommunication system simultaneously, much simpler and cheaper solutions were now available.

As far as the rolling-stock equipment was concerned, generalisation was particularly dangerous. Much depended, for example, on whether the class of traffic to be handled permitted full advantage to be taken of the better adhesion of a.c. equipment. Much also depended on how the equipments could be simplified and cheapened. The prospects appeared to be good. British Railways had over 1,300 km. of lines on which to experiment with prototypes before putting them in commercial service, and could now concentrate on providing the simplest solution.



First-class motor-coach for suburban electric service

ALL-STEEL ELECTRIC SUBURBAN COACHES for South African Railways

Stock destined for use for Cape Western and Reef suburban lines and built in South Africa

AT THE beginning of 1958, 349 all-steel lightweight coaches designed and built by the Metropolitan-Cammell Carriage & Wagon Co. Ltd., went into service on the Reef suburban electrified lines of South African Railways. Currently going into service on the Cape Western and Reef suburban electrified lines, as they are completed in train sets, are 449 similar coaches, but with increased seating capacity, built by Union Carriage & Wagon Company (Pty.) Limited, at its Nigel (Transvaal) Works.

These are made up of 56 motor-coaches with guard's and baggage compartment and upper-class seating; 57 motor-coaches with guard's and baggage compartment and third-class seating; 60 driver-trailer coaches and 228 trailer-coaches with upper-class seating and 48 trailer-coaches with third-class seating. Principal dimensions are as follow:—

Particulars	ft. in.
Length over body-end panels	60 3½
Width over body-side panels	9 3
Bogie centres (motor)	41 0
Bogie wheelbase (Motor)	9 0
Bogie centres (trailer)	44 6
Bogie wheelbase (trailer)	6 9

The driver-trailer is an entirely new type of coach. Seating layout is typical of all upper-class coaches under construction and differs from the Metro-Cammell-built coaches in that the latter have a centre aisle with two-passenger seats on each side to provide seating for 62 passengers in the plain trailers as compared with seating for 72 passengers in the Union Carriage-built plain trailers. All coaches have exterior bodysides finished in the new S.A.R. colour scheme of gulf-red with window band and doors in French-grey, with silver-aluminium roof.

The Metro-Cammell-built coaches were described in the May, 1958 issue of "*Railway Engineering*" and it is proposed, therefore, to mention in the present article modifications and variations which have been introduced in the Union Carriage-built coaches, and to make special reference to locally-made assemblies and components in order to illustrate the great progress made by South Africa along the road towards industrial self-sufficiency.

Largest local contribution

By far the largest single local contribution is, of course, the "Cor-ten" steel sheets, plates, and sections which are exclusively of South African origin supplied by the Iron & Steel Corporation through its sales organisation. For the present the Iron & Steel Corporation is not rolling "Cor-ten" sheets wider than 36 in. and consequently, where design or manufacturing techniques call for greater width this is obtained by the "Peco-foil" automatic welding of two or more sheets.

With the exception of headlights for the motor coaches, the sub-contract for the whole of the traction, heating and lighting equipment for these cars was awarded to A.E.I. South Africa (Pty.) Limited, on the understanding that, while early equipment would of necessity be supplied by the parent company in England, a very substantial part would be manufactured in South Africa by its associates, the First Electric Corporation. These locally-made components are being manufactured to the designs of A.E.I., which is also supervising the initial work, and include traction motors, pantographs, items of control equipment, jumper and busbar couplers, and many other minor details. In addition, h.t. and l.t. cables, conduit and fittings, lighting and heating equipment, and blower fans are all being manufactured in South Africa.

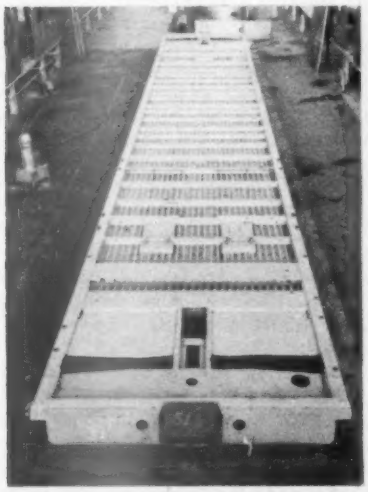
The general body construction of all coaches is based on the integral tubular anti-telescopic principle, which is to consider the whole bodyshell as a rectangular tube suitably stiffened at intervals along its length by lateral rings formed by the transoms, pillars, and carlines. These lateral rings are positioned by continuous longitudinal stiffening-members consisting of the solebars, cantrails, bodyside rails, and purlins. All these members are welded at the joints with other members, and also to the outer skin, the whole forming the self-supporting and load-carrying body-shell designed to carry the maximum pay-load and also meet a longitudinal-compression 200-ton loading test called for in the specification.

Structural members

All structural members are of "Cor-ten" steel one of the properties of which is its excellent comparative corrosion-resistance. The Iron & Steel Corporation is licensed by United States Steel Corporation to produce "Cor-ten" for South Africa.

The underframes are fabricated from cold-formed or pressed-steel sections

for the solebars, bolsters and transoms. A sub-floor consisting of longitudinally-corrugated steel panels is fitted to the trailer coaches, the panels being butted and welded to each transom face, and to the solebars. A subsidiary bolster has been added immediately at the rear of the drawgear pocket, and between the normal centre-plate bolster and headstock, to spread buffing loads and distribute these across the width, through the solebars, transoms, and sub-floor panels. The headstocks are fabricated from rolled-steel plates. A substantial anti-telescoping casting is secured to each headstock in the centre to overcome any tendency to override adjacent coaches in the event of a collision. The underframe of the motor-coach is considerably stronger than that of the trailer-coach in order to carry the many heavy items of electrical equipment.



Trailer-coach underframe

The bodysides are built up from cold-formed and pressed steel sections which make up the principal framing members to which 14 s.w.g. exterior panels are fillet- and plug-welded. Body pillars are 12 s.w.g. and the cantrails are 10 s.w.g. Top-hat sections of 14 s.w.g. are used for the light rails and waist rails. All framing members both vertical and horizontal are continuous and body pillars are notched as required to pass the longitudinal rails. The panels are blanked and formed for window openings and are "Peco-foil" automatically welded before being plug-welded to the framing.

Roof construction

The principle of the roof construction is similar to the bodyside; the carlines are of pressed-channel section, the purlins of V-section, and cantrails are of irregular-channel section. Welding throughout the roof is used except where the gutter is attached to the roof by riveting. The roof sheets are of 16 s.w.g. thickness.

The problem of corrosion was very carefully considered throughout all stages of the original Metro-Cammell design in order to eliminate as far as possible any conditions which would be favourable to corrosion.

Thermal insulation

Corrosion was considered together with thermal insulation and sound-deadening aspects and Union Carriage was able to draw upon its extensive experience with coaches designed for other parts of the world where comparable climatic conditions obtain. After erection the body-shells are grit-blasted inside and out, and a vinyl wash followed by zinc-chromate primers are applied. Next comes a $\frac{1}{8}$ in. thickness interior application of "Autokote" which combines excellent anti-corrosion properties with those of sound-deadening. Thermal protection and noise reduction is achieved by the use of 2 in. thickness of fibreglass thermal insulating material, manufactured locally and supplied in resinbonded pads, and fixed by adhesive and Nelson studs to the interior bodysides, ends, roof and under-floor. The use of fibreglass is a comparative recent breakaway from tradition so far as South African Railways is concerned, but it was felt that due to the particular problems of corrosion in South African climates, easy removal of the thermal insulation was essential to facilitate complete examination of structural parts.

The general interior finish of the first class coaches is buff-coloured "Panelyte" p.v.c. veneered to hardboard with self-coloured anodized-aluminium mouldings and fittings while the ceiling is finished in white "Cobex" p.v.c. veneer. An important feature of these coaches, consequently, is that interior painting is eliminated, and for cleaning purposes all that is necessary is a wipe over with a clean, damp cloth. Third class coaches are finished with hardboard panels which are painted and the ceilings are covered in white "Cobex" p.v.c. veneer. Ventilation by "Greenwood" extractor ventilators is provided in all coaches.

Aluminium alloy mouldings

In the upper class coaches, bodyside panels below waist level are $\frac{1}{4}$-in. thick nominal made up from $\frac{3}{16}$ in. hardboard plus the two "Panelyte" veneers each ·055-in. thick (the interior unseen veneer having been added for balancing). Mouldings generally are aluminium alloy and are polished and self-colour anodised. The lower portion of the bodyside up to a distance of approximately 12 in. from the floor level is covered with stainless-steel panels for added protection.

The interior finish of the third class coaches is generally similar to the upper class, the main difference being the omission of the plastic veneer and the aluminium mouldings being painted.

Stainless-steel panels are unnecessary behind longitudinal seats but these are retained on cross partitions and windscreens. Panels below waist level are painted in a chocolate shade, while above the waist to cantrail level they are buff-coloured.

Ceilings are made up for all classes of cars from $\frac{1}{8}$ in. Masonite to which is bonded the white "Cobex" p.v.c. veneer. The trailer-coach ceiling is semi-elliptical, but in the case of the motor-coach, there is a raised centre giving a clerestory effect in order to provide accommodation for the ducts conveying clean air to the traction motors on the trailing end bogie. These ducts are taken down between the body exterior and interior panels in the trailing end bay.

Lighting

Upper class coaches are equipped with fluorescent lighting tubes running centrally down the entire length of the ceiling. The Perspex-covered fittings are finished in self-colour anodised aluminium and operate on 110-V. d.c. supplied from the motor generator set on the underframe. 100-V. d.c. incandescent fittings are used for lavatories and all non-passenger compartments. In the third class coaches there are incandescent fittings, at 110 V d.c. running centrally down the ceilings.

Bodyside drop windows, 3-ft. in sight width, are provided on all coaches, and are adequately balanced in all positions by a No. 3 Hera equaliser. All windows are fitted with toughened glass sliding in felt-lined channels, and a blue coloured nylon-cloth blind is added on all upper-class coaches.

Windows

A particularly noteworthy feature of the window arrangement is that the whole assembly of window, balance, guides, blind, and interior finish panel below the waist is provided as a self-contained unit, which is readily removable from the inside for maintenance purposes. It is jig-built for interchangeability and except where attached thereto, is completely independent of the coach structure, and the assembly has been designed so that the blind can be removed without displacing the window unit. The inside finish of the latter consists of a matching panel and colour anodised aluminium-alloy extrusions to match the remainder of the interior. Provision has been made for the easy adjustment of the "Hera" equaliser to balance exactly the window weight, thus avoiding the need for the use of semi-positive stops. One positive stop is provided to enable the window to be locked when closed. All upper class coaches have an inclined glass vane fitted outside each window to enable it to be lowered a few inches in inclement weather.

Motor-coach shell interior

Seating arrangements in coaches

Upper class coaches have back-to-back cross seats which are designed as units to be easily removable. They are built up from welded tubular frames, with foam-rubber fillings, trimmed with blue p.v.c. material. The seats in the third class coaches are longitudinally arranged down each side of the car and are constructed of steel frames with wooden slats.

The floors in the trailer coaches consist of 1-in. thickness waterproof plyboard laid on the crossbars in panels of approximately 8 ft. 7 in. x 3 ft. 6 in. The floor-covering is " Poly-flor 90," a wear-resisting, flexible material which is bonded to the plyboard by means of special adhesives and having all edges fused together to form a jointless and unpermeable surface. Due to the need for sound insulation in proximity to the electrical equipment on the motor-coaches, the steel corrugations in the sub-floors of these cars are filled with strips of cork overlaid with cork slabs on top of which is laid $\frac{1}{8}$ in. thickness " Masonite " sheets. The floor-covering is " Poly-flor 90 " applied in the same manner as in the trailer coaches.

Standing room

Each car has two large passenger doorways equipped with sliding doors. These doorways which open into large vestibules enclosed by four windscreens have been designed purposely to provide room for standing passengers. The windscreen is built up from steel sheet below waist level, with an impressed aluminium panel bonded to it on the doorway face for finish.

The sliding doors are in pairs and equipped with a " Faiveley " sympathetic gear to enable each leaf to move in opposite directions when operated. Doors are arranged to be power-closed by the guard, although they can also be closed manually. The doors are opened manually only after release by the guard. In the event of an emergency, opening of the doors can be achieved, but requires the use of considerable force to do so. Accidental door opening is not possible.

The electro-pneumatic operation of the doors is as follows:—Air is admitted to the door engines at 55 lb./in. when the guard operates the "closing" button in his van. The operation of this button excites relays located in the underframe which in turn operate electro-pneumatic valves located centrally between doorways.

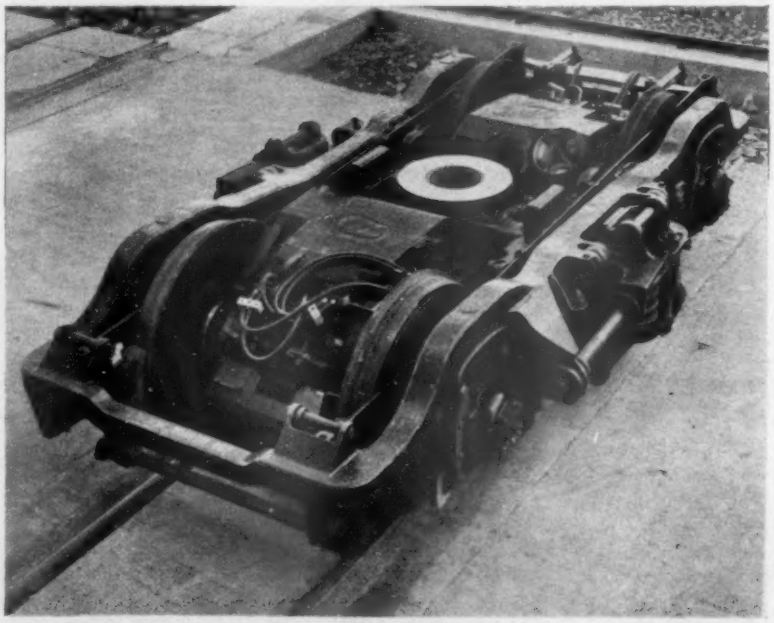
Guard's control box

A separate guard's control box is fitted in the vans to control each side of the train. Indication is provided at every control box and in every driver's cab to give visual indication of the door positions. The operating gear has been designed to meet specified S.A.R. requirements in collaboration with the French company, Etablissements L. Faiveley. The doors, themselves, are of sandwich construction fabricated from aluminium outside sheets and poly-urethene filling, and are of the trackless type, top hung and designed to give a clear doorway at floor level when open. The operating mechanism and moving parts are completely shrouded to prevent the ingress of dirt.

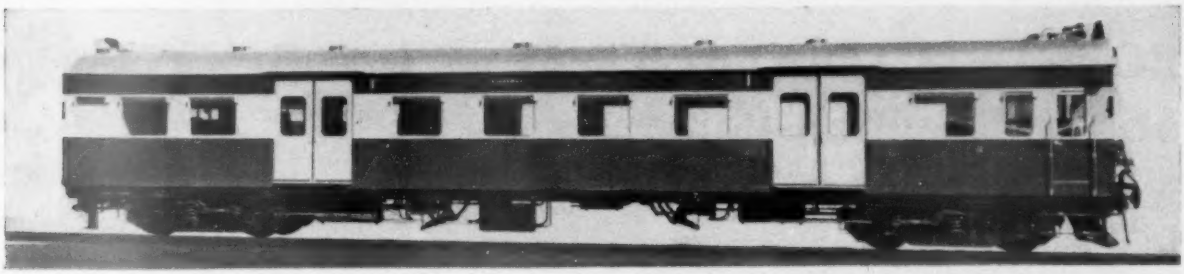
Toilet facilities

A lavatory is provided in every trailer-coach, the upper class lavatory being finished in white glossy melamine-faced " Panelyte " whilst the third class lavatory has painted zinc-coated steel sheets. The floors in all lavatories are covered with mottled blue/grey rubber, and the toilet unit, of stainless steel, is fed from a roof tank of 45-gal. capacity, which is arranged for refilling from both sides of the coach at solebar level.

Both motor- and trailer-coach bogies are of the " Commonwealth " cast-steel frame, equalising-beam type—more than 90 per cent. of the total value of the bogie components being manufactured in South Africa. The bogies are equipped with large-diameter cast-steel centre bearings with non-metallic wearing plates and sleeves. Due to the large centre bearing, conventional side bearers are unnecessary, and are replaced by safety stops which have a nominal clearance of $\frac{1}{4}$ in. each side. All bogie springing is by nests of helical springs, damped in all cases by " Houdaille " shock absorbers for comfortable riding, and to that end, the springing has been designed to give maximum deflection under load compatible with the working clearance re-



Motor bogie "C" on suburban electric stock



L-51-D driving trailer for suburban electric service

quired between the bogie parts and the underframe.

The radial movement of the bogie bolster is controlled at its outer ends by bolster anchors, which flexibly locate it to the bogie side frame. Each motor-bogie has both axles motorised, the motors being axle-hung with their noses flexibly mounted on to the bogie transoms. The bogies are equipped with orthodox equalised clasp brakes operated from the underframe by the usual pullrod linkage. Motor-coaches are equipped with four 21 in. vacuum-brake cylinders, while two 21 in. cylinders are sufficient for the trailer coaches.

Safety device

Approximately one-quarter of the total body portion of the motor-coach length is occupied by electrical and equipment compartments, and access to these can be obtained only by operation of the mechanical interlocking gear, which automatically lowers the pantographs, and cuts off the power supply.

The main electrical compartments are the high tension, and auxiliary high tension, these being slightly pressurised to prevent the ingress of dust when travelling. The high tension compartment houses, among other items, the main switch-group frame and this unit has been mounted in such a way that it may be removed directly out of the compartment without being dismantled.

Other equipment is housed in the low tension and various other small cubicles. Two other compartments allow for the intake and filtering of the fresh-air supply for cooling the traction motors and this is accomplished by taking in air at the hip of the roof from where it passes down into the air-settling chamber. From here it travels through a bank of "Vokes" filters, which occupy the whole area of a cross partition, and into the air-intake chamber proper. This compartment houses the booster fans which are pre-set to force-ventilate the traction motors according to service conditions. Air can also be taken from the settling chamber by the traction motors themselves for normal cooling.

The ducts to the bogie at the leading end are taken directly downwards from the air chamber and thence to the motors, but those supplying air to the trailing end bogie motors, as mentioned previously, are built into the roof section on each side between roof and ceiling, and led down the bodysides to the underframe. The cross-sectional area of each duct is approximately 100 sq. in. The air connection between the coach body and the motors on the bogies are made by the use of reinforced-leather bellows secured to the motor by a clamping ring and to the underframe by a flanged ring.

Current collection

Current is collected by any one of the two pantographs from an overhead wire which has an average potential of 2,900 V. varying on the normal working conditions between 2,700 and 3,200 V. The control is of the electro-pneumatic type, employing unit switches housed in the high tension compartment, and remotely controlled from the master controller in the driver's cab. Acceleration is controlled by two current armature circuits, one being used in the "motor-series" position and the other in the "motor-parallel" position. An overriding time-delay really is fitted.

Auxiliary supply

The auxiliary supply of control current is obtained from a motor generator set mounted on the underframe, the motor being driven from 3,000 V. line supply while the generator supplies current at 110 V. In the event of failure of this set, control supply can be obtained from the other motor-coach in the train.

The four traction motors on each motor-coach are connected electrically in pairs, permanently in series, so that each motor, while insulated for 3,000 V. to earth, has only 1,500 V. across its terminals. The pairs are operated in series, or in parallel; one stage of field weakening is provided for which two inductive shunts are used. Provision is made for the isolation of any pair of motors which may become defective without interference with the working of the remaining motors.

Other items of auxiliary equipment on the motor coach are the exhauster, compressor, and main resistance frames, which are all mounted on the underframe.

DISNEYLAND-ALWEG MONORAIL EXTENSION

The Disneyland-Alweg monorail has now been extended by a further 8,767 ft. beamway to connect Anaheim with the Disneyland Hotel. With 900 ft. of beamway sidings, and three new four-car trains, the cost of the extension is about £710,000, bringing the total for the 2½ miles of beamway, pylons, stations and rolling stock up to £1,180,000 in all.

The new trains designed for speeds up to 45 m.p.h., but capable of doing 80 m.p.h. in favourable conditions, each carry 106 passengers as compared with 82 in the original trains put into service in June, 1959. The drive and braking is on rubber-tyred wheels running on the top of the beam, stabilising wheels contacting each side of it. Each train has six 55-h.p. d.c. motors, two for each set of driving wheels mounted on each side of the second, third and fourth of the train's five bogies.

Current pick-up

Current is picked up by carbon brushes on the first and second bogies of each train from a lower (positive) bar, and is returned to an upper negative bar. Dynamic braking is provided to supplement bus-type air brakes.

The beams are of concrete, from 32 ft. to 42 ft. in length, 1 ft. 8 in. wide and 2 ft. 10½ in. deep, their designed strength being 5,000 lb. per sq. in. There are, however, 50 60-ft. beams 3 ft. 4 in. deep used on straight sections of alignment and each weighing 23 tons. The beams are carried on pylons at a height of 31 ft. above Harbour Boulevard, but in open land are only 5 ft. above ground level. Since this line was opened it has carried 4,370,000 passengers and train-mileage is over 60,000 miles.

TRANSISTOR COURSES

The Borough Polytechnic, London, S.E.1, is to run a series of courses on basic transistor measurements and applications on Tuesday evenings from October 24 and on Wednesday afternoons from October 25.

BO-BO-BO LOCOMOTIVES on the Rhaetian Railway

Summary of an account by the Chief Mechanical Engineer of Rhaetian Railways describes practical experience gained with 2,400-h.p. metre-gauge stock

In 1958, the metre-gauge Rhaetian Railway commissioned two 2,400-h.p. Bo-Bo-Bo locomotives of a new articulated design described in *The Railway Gazette* of August 1, 1958. These locomotives have been in operation for over three years and have each covered more than 250,000 miles so that there has been ample opportunity to gather experience with them. In view of the various innovations embodied in these locomotives, a summary of a report published by Mr. A. Bächtiger, Chief Mechanical Engineer of the Rhaetian Railway in the German journal *Elektrische Bahnen* (No. 7, 1961) may be of interest.

Many components used for these locomotives are identical with those of the earlier and already very successful Bo-Bo design. But, as the axle-load is less than 11 tons compared with the 12-ton load of the Bo-Bo locomotives, wear on the traction motors, transmission, and axles has been even less, and has in fact been virtually non-existent. Total running resistance on level and straight track is no greater than 4.5 kg. per ton, compared with, for example, a resistance of 6 kg. per ton of the earlier 1,200-h.p. CC locomotives of equal weight (65 tons). This alone accounts for a saving in electric energy consumption estimated at about £100 a year per locomotive.

Transverse coupling arrangement

The new type of transverse coupling arrangement adopted for the three bogies has amply fulfilled the high expectations cherished at the time of installation. The bogies are extremely flexible, and the footplate men unanimously praise the comparative ease with which the locomotives can start and run under the most adverse conditions of curvature, gradient, and weather. This is all the more remarkable as the adhesion weight of the Bo-Bo-Bo locomotives is only about 40 per cent higher than that of the Bo-Bo locomotives, while the maximum trailing load is over 50 per cent higher. The high tractive efforts occurring in this connection give rise to considerable spring travels at the couplings, a fact which had to be taken into account in choosing the length of the airbrake and heating cable connections.

The greater smoothness of running has been confirmed by systematic measurements of transverse vibrations which are markedly less pronounced than with the four-axle locomotives. Radial wheel-tread wear has been as low as 0.2 mm. per 10,000 km. One of the two locomotives has been equipped with a very effective type of Sécheron wheel-flange lubrication, not because of any adverse experience or misgivings in relation to locomotive wheel wear, but because it was feared that, as a result of the greatly-increased trailing loads, rail wear might be increased. With this lubrication system, a special and particularly adhesive oil is sprayed by compressed air on the wheel flanges of axles 1, 2, 5, and 6 in a quantity depending on the distance covered, inasmuch as the spraying is automatically actuated by the Brown Boveri deadman's device at intervals of about 200 metres. At a cost of about £40 a year for lubricating oil and additional compressed air consumption, this device has provided an elegant solution to the problem of wheel flange and rail lubrication.

Axlebox roller bearings

The swing roller bearings used for the axleboxes are being serviced at intervals of 18 months. There has not been a single case of trouble with them, although some trouble was experienced with the plastics bearings originally used for the transmission shafts of the transverse coupling in the centre of the intermediate bogie. These bearings showed excessive wear and were replaced by conventional brass bearings which have since been found satisfactory.

The brake equipment has worked to perfect satisfaction, and the well-proven SLM VL 20 rotary vacuum pump was found to be adequate even for the increased trailing loads. Maintenance costs incurred for gearing and spring drive mechanism, brake rigging, and other mechanical parts were, as expected, about 50 per cent higher than for the four-axle locomotives.

The central link connection permitting the two sections of the articulated locomotive body to move vertically with respect to each other, which is one of the outstanding new features of these locomotives, requires no maintenance and has given complete satisfaction. Its advantages were specially appreciated on one occasion when one of the locomotives accidentally overran the non-buffer end of a siding and the first three axles became derailed. The damage was insignificant and could be repaired within a day, while a similar incident with a comparable locomotive of traditional type would have caused much heavier damage which it would have taken weeks to repair. The transitions have meanwhile been protected with bellows to reduce dirt pollution of the doors.

Anti-skid device

The anti-skid device has been found widely satisfactory and has resulted in a lower brake sand consumption.

Some modifications have been necessary to the ventilation system as the machinery compartment, though only 25 per cent larger than with the Bo-Bo design, was ventilated by the 50 per cent greater suction effect of the six traction motors so that the machinery and equipment collected too much dirt as a result of the strong draught. The ventilation effect was therefore reduced, and it is intended to mount suction louvres with improved filter effect.

As far as the electrical parts are concerned, those taken over from the earlier Bo-Bo type showed no appreciable difference in practical performance. In this connection, special attention was paid to the Brown-Boveri low-voltage control system which, to save weight, had been adopted in lieu of the high-voltage control system of the Bo-Bo type. The new system has been completely satisfactory in spite of the fact that the heavier currents call for higher contact pressures. These higher contact pressures have resulted in slightly greater mechanical wear.

Exciter resistance modified

As a result of experience during the first winter, the exciter resistance of the regenerative circuit, which proved to be unduly affected by temperature fluctuations, was slightly modified and has since worked satisfactorily.

The aluminium strips of the pantographs show a slightly increased wear due to the heavier currents.

On the whole, the new locomotives have fulfilled all expectations, and it is intended to increase their number as and when the old CC locomotives, dating from the 1920's, must be replaced.

PERSONAL

British Transport Commission

MR. S. K. GARRATT, formerly of Shell International Chemical Co. Ltd., who, as recorded in our October 13 issue, has been appointed Public Relations Adviser to the British Transport Commission, qualified as a solicitor in 1939. During the war he served with H.M. Forces and was a military courts magistrate in Berlin. He joined Shell in 1947 as a Legal Assistant to the General Manager of the Shell Co. of China, Ltd. In 1951 he was appointed Staff Manager in Ceylon and two years later went to Nigeria, taking charge of public relations there. He returned to Britain in 1956 as Manager of Public Relations, Shell Chemical Co. Ltd., and moved to Shell International Chemical Co. Ltd. earlier this year.

Mr. S. K. Garratt

MR. C. W. KING, M.I.C.E., Chief Civil Engineer, British Railways Central Staff, British Transport Commission, who, as recorded in our October 13 issue, has retired, was educated at Dover College, and then became a pupil of the late Sir Percy Tempest, then General Manager & Chief Engineer of the South Eastern & Chatham Railway. In 1922 he joined the staff of the Resident Engineer, S.E.C.R., and, after the formation of the Southern Railway, was engaged on constructional works for electrification schemes, including the remodelling of Cannon Street Station, and conversion of the Brighton line. In 1933 and 1934 Mr. King was attached to the London East Division, and in 1935 became Technical Assistant to the Assistant Engineer (General Maintenance), and helped with the organisation for the rearrangement of lines from Waterloo to Wimbledon. Later he acted as Assistant for Electrification Works to the Chief Engineer during the initial stages of the electrification of the Portsmouth line. In July, 1936, Mr. King became Acting Assistant Divisional Engineer, London East Division, and he was confirmed in that post in January, 1937. He was appointed Divisional Engineer for the same division in 1942. In 1947 Mr. King became New Works Engineer, Southern Railway, in 1948, Assistant Civil Engineer, London Midland Region, and Chief Civil Engineer, British Railways Central Staff, in 1958.

Mr. C. W. King

British Railways

MR. W. H. WEBB, Assistant Supplies & Contracts Manager, Swindon, British Railways, Western Region, has retired.

MR. F. D. PATTISSON, Assistant (Research), Traffic Headquarters, British Railways, Western Region, has been appointed District Traffic Superintendent, Birmingham.

MR. J. R. BARROW, Relief Stationmaster, Middlesbrough District, British Railways, North Eastern Region, has been appointed Stationmaster, Rowlands Gill.

MR. R. W. BROWN, Instructor, Regional Work Study School, Royal London House, E.C.2, British Railways, Eastern Region, has been appointed Senior Instructor.

MR. H. W. HOLLAND, Internal Check & Audit Assistant, Chief Accountant's Department, British Railways, Eastern Region, has been appointed Assistant to Accountant.

MR. H. J. CHESTON, Production Assistant, Chief Mechanical & Electrical Engineer's Department, Swindon, British Railways, Western Region, has been appointed Production & Contracts Engineer, Chief Mechanical & Electrical Engineer's Department, Doncaster, British Railways, Eastern Region.

MR. C. W. EDWARDS, General Agent for Belgium & Luxembourg, Brussels, British Railways, Southern Region, has been appointed Assistant Commercial Superintendent, Shipping & Continental Department, Victoria.

The London Midland Region of British Railways has announced the following appointments: MR. S. H. GOULD to be Movement Officer, Euston; MR. A. J. JOHNSON to be Commercial Officer, Euston; MR. D. M. HOWES to be Assistant (Movements), Euston; MR. J. COWING to be Assistant (Commercial), Euston; MR. L. W. LEPPINGTON to be Assistant Divisional Traffic Manager, London (Midland), and MR. L. A. METCALF to be District Commercial Manager, Leicester.

London Transport Executive

MR. A. H. GRAINGER, MR. L. C. HAWKINS, MR. B. H. HARBOUR, and MR. ANTHONY BULL have been re-appointed full-time Members of the London Transport Executive. The RT. HON. LORD WILLIAMS has been re-appointed a part-time Member.

MR. G. R. KENT and MR. M. H. WHEAT have been appointed Principal Executive Assistants, Chief Signal Engineer's Department, London Transport Executive. Mr. Kent's title is Maintenance Engineer (Signalling) and Mr. Wheat's Design Engineer (Signalling).

Industrial

MR. J. W. WARNER has been appointed to the board of Alkaline Batteries Limited.

MR. R. A. PITTMAN has been appointed Deputy Director of the Council of British Manufacturers of Petroleum.

MR. J. SCOTT MCBRIDE has been appointed Director of the Timber Development Association.

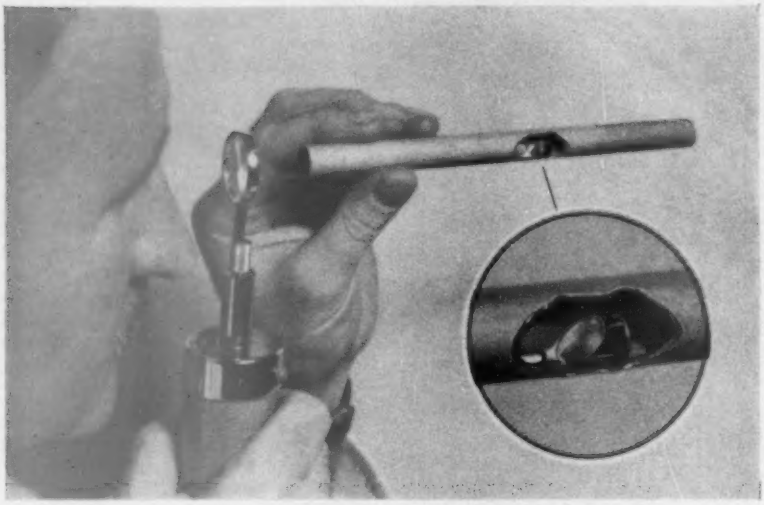
MR. W. H. RIGG has been appointed Managing Director of Firth Cleveland Tools Limited.

MR. A. JOHNSTON has been appointed Public Relations Manager, Bristol Siddeley Engines Limited.

MR. A. C. MAIN has been appointed Director of Manufacturing Services, Associated Electrical Industries Limited.

MR. J. D. SWALLOW has been appointed Advertising Manager, Yale & Towne Manufacturing Company.

NEW EQUIPMENT *and Processes*



BORE-INSPECTION INSTRUMENT

Endoscopes, also known as introscopes, are the normal means of inspecting the bores of holes, and these can be had up to 30 ft. long for many diameters with various angles of view. A new range of bore viewers, comprising two sizes, each available in three lengths, is now on the market. The series 316 is designed for holes of $\frac{3}{16}$ in. to $\frac{9}{16}$ in. in diameter, using a mirror $\frac{11}{64}$ in. wide and a probe 0.08 in. in diameter. The series 380 is designed for holes of $\frac{7}{16}$ in. to $1\frac{1}{4}$ in. in diameter, using a mirror $\frac{3}{8}$ in. wide and a probe of 0.109 in. in diameter.

These viewers are designed for workshop use, are made of brass and nickel-plated. Delicate adjustment and focusing are avoided. They consist of three parts; the battery holder forming a handle, the light probe, and the sleeve with an elliptical mirror. The side walls of the bore are illuminated by the lamp and viewed in the mirror through the magnifying lens. For 2 in. viewers, magnification is 4x and for 6 in. and 8 in. viewers it is 2x. Used without the sleeve, the light probe enables the bottom of blind holes, valve seatings, and so forth, to be inspected.

Further details can be obtained from P. W. Allen & Company, 253, Liverpool Road, London, N.1.

LIGHTWEIGHT TORSION TESTER

The Tinius Olsen " Lo-Torq " torsion testing machine has been designed to carry out tests up to 10,000 in. lb. This is within the range of Universities and Colleges and is suitable for wire and other light materials in industry.

Testing is carried out in one direction of rotation, and the three-jaw holding chuck is graduated in degrees to determine the angle of twist. Three alternative torsion capacities are available 10,000, 5,000, or 2,000 in. lb. Specimens can be up to 1 in. in diameter and 18 in. in length. The load is weighed by torque bars and indicated on a 10-in. dial. On the standard model, two ranges of reading can be used; full scale or 1/10th scale. Operation is either manual or by single-speed motor, operating at 180 deg. per min. The motor can be engaged at any time when precise movement is not required or for destruction or routine testing. An alternative motor having electronic variable speed drive from 5 to 180 deg. per min. speed can be obtained.

Another machine also available has the same capacity but in four ranges, is fitted with the variable-speed motor drive, and has a 28-in. dial.

Further details can be obtained from Edward G. Herbert Limited, Atlas Works, Levenshulme, Manchester, 10.

SMALL-BORE TUBE BENDERS

The " Quikset " benders, as they are designated, are light enough to be carried about, are stated to be capable of producing commercial quality bends without filling or heating, and can be used with the tubing only partly disconnected.

The range permits the operator to carry out bends " in the hand " without removing the work to a bench or to a floor-standing machine. This is especially useful for handling electric conduit, small-bore piping for hydraulic or compressed-air control equipment, or instrument work.

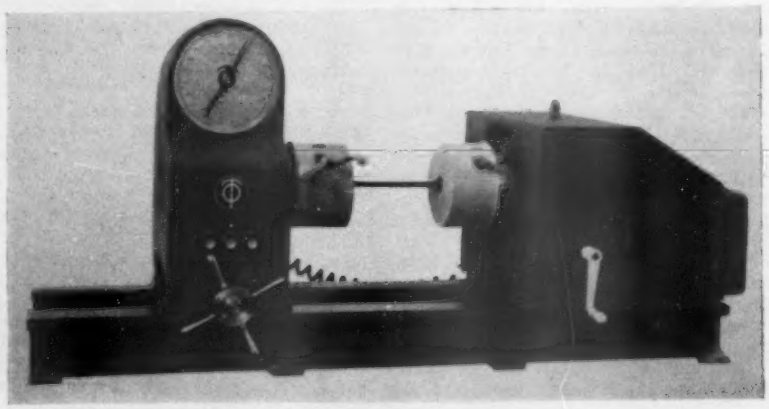
The benders are made in eight sizes for $\frac{1}{4}$-in., $\frac{3}{8}$-in., $\frac{1}{2}$-in. and $\frac{3}{4}$-in. i.d. copper tubes to B.S.S.659, and for $\frac{1}{4}$-in., $\frac{3}{8}$-in., $\frac{1}{2}$-in., and $\frac{5}{8}$-in. o.d. light-gauge ferrous and non-ferrous tubes up to 16 s.w.g. thick.

Further details can be obtained from Chamberlain Industries Limited, Staffa Works, Argall Avenue, London, E.10.

STRAPPING TAPE

The " Tufstrap " flexible strapping tape comprises multiple strands of light cord, giving the tape a tensile strength up to 430 lb. in the $\frac{3}{4}$-in. width, or 290 lb. in the $\frac{1}{2}$-in. width. This material is completely flexible, can be printed for identification and burnt after use. Two types of strapping machine are available which apply metal seals to the tape in a manner similar to steel tape strappers.

Further details can be obtained from P. P. Payne & Sons Limited, Haydn Road, Nottingham.



Model of entrance to proposed Channel tunnel at English side

The Channel Tunnel

Cheaper than a bridge and better estimated return

The Channel Tunnel Study Group which has just made public its proposal for a Channel tunnel comprises the English Channel Tunnel Company, in which the British Transport Commission, as successors to the Southern Railway, are shareholders, and other associates constituting the British group; the French Channel Tunnel Company, in which the French Railways are the main shareholders, and which, with their associate the International Road Federation (Paris Office) constitute the French group, the Compagnie Financière de Suez, and Technical Studies Inc. of New York.

The group consider that a tunnel is the best method of providing a link with the Continent because it would cost only £105 million against £210 million for a bridge and would bring in a golden estimated return on capital invested. It would not interfere with navigation in an area heavily used by shipping; it would be unaffected by fog, snow, ice and other weather hazards; and, because the entrances to the tunnel would be set well back from the coast, it would not lead to further congestion on the already heavily loaded coast roads and in the Channel port towns.

The traffic estimates used in arriving at a conclusion were taken from the economic survey prepared for the Study group.

	Passengers	Accompanied Vehicles *	Goods (tons) Without Common Market	Goods (tons) With Common Market
1965 ...	3,180,000	676,000	1,250,000	1,710,000
1980 ...	4,831,000	1,127,000	1,640,000	2,530,000

*Including buses, motor coaches and caravans.

Two types of trains would be used for passenger traffic. One type will be Continental-gauge trains for long distance traffic to Germany, Switzerland, Italy, and the South of France, with existing stock which at present starts from Calais. The terminus for these trains will be at the English end of the tunnel, where there will be connecting railway services to London and other cities. The other will comprise through trains between London and Paris or Brussels, of special rolling stock built for both British and Continental gauges. These trains will be multiple units or will be hauled by "polycurrent" electric locomotives able to travel on the British or Continental railway track. These trains will not terminate at the tunnel terminals.

Railway goods traffic will normally be carried in ferry wagons which at present pass freely in Europe and Great Britain on the train ferries. The existing stock, which is considerable, can easily be increased if necessary. Heavy lorries, loaded, will be conveyed through the tunnel on specially designed well wagons. The dimensions will be adequate to enable all but a few outsize lorries to be transported.

Accompanied cars will be carried by special sets of covered wagons carrying either 150 or 300 cars so designed that a car will be able to drive straight through from one end of the train to the other. Drivers and passengers will be asked to remain in their vehicles throughout the tunnel journey. This is to ensure that drivers are ready to drive off immediately on arrival at the other end of the tunnel.

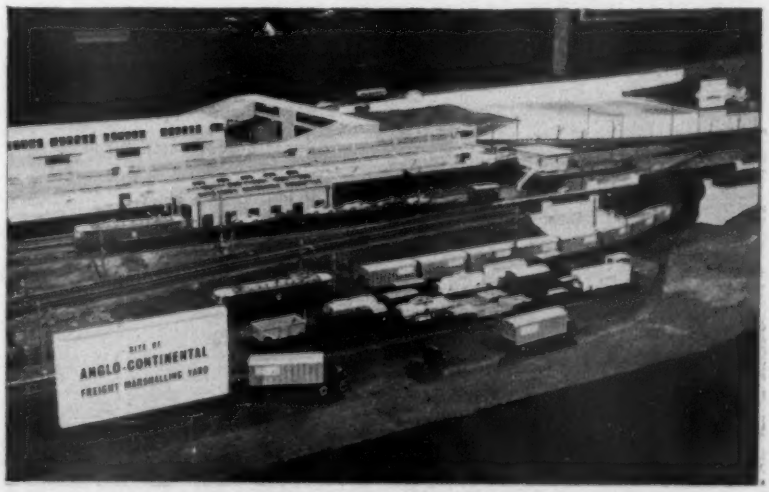
The plans for the layouts of the terminals and of the tunnel services have been based on the principle that car-owners should not have to wait or book in advance.

The cost of taking a car through the tunnel would be cheaper than on either of the present sea and air ferries. The charge for the average family saloon with driver would be £5 16s. With driver and two other occupants it would be £7 14s. compared with £10 16s. by sea or £18 9s. by air at current rates.

The following speeds and journey times through the tunnel (32½ miles) would be achieved:—

	Speeds Max. m.p.h.	Speeds Average m.p.h.	Total Time in the Tunnel Minutes
"Crack" Trains	87	70	28
Ordinary Passenger Trains	87	65	30
Car-Carrying Trains ...	75	60	33
Fast Goods Trains ...	60	50	39
Ordinary Goods Trains	50	40	49

Automatic-block colour-light signalling would be used with "both way running" on both tracks. This arrangement would ensure that the tunnel would never be closed for maintenance operations since it would be possible to plan the work so that it would be carried out during periods of light traffic using one tunnel between the cross-overs for traffic in both directions during the time the opposite tunnel is under inspection and repair.



Model of site of freight marshalling yard for proposed Channel tunnel

Staff & Labour Matters

Railway pay claims

The claims of the three railway trade unions for improved rates of pay for railway salaried and conciliation staff were declined by the British Transport Commission at a meeting of the Railway Staff Joint Council on October 12.

The main argument of the Unions in support of their claims was that pay increases were justified to maintain relativity between railway rates of pay and those paid in the industries on which the Railway Pay Committee of Inquiry (the Guillebaud Committee) based their comparisons in December, 1959. The Commission's representatives gave explanations as to why, in their view, railway pay should not be expected, irrespective of any other considerations, to move automatically with pay increases in the particular industries covered by the Guillebaud Inquiry.

They also explained that they did not consider the arguments advanced by the Unions' representatives constituted grounds for a further increase in pay at this time.

The Commission's representatives reply will be considered by the respective Executive Committees of the Unions, who will decide what the next step in pursuit of their claims will be.

The Railway Staff Joint Council is the first stage in the negotiating machinery and the Unions can now refer their claims to the Railway Staff National Council, and if still rejected, to arbitration at the Railway Staff National Tribunal.

The Unions' representatives protested strongly that the Government had accepted the objective underlying the report of the Guillebaud Committee—that fair and reasonable wages should be paid to those engaged in the industry.

Transport of 100-ton car

A hot-metal mixer-type car, weighing over 100 tons, was recently transported by the North Eastern Region of British Railways to the Steel Company of Wales from the works of Head Wrightson, Teesdale Limited, Thornaby.

The car resembled a large torpedo-shaped ladle mounted on rail wheels, and as it was out-of-gauge (at times requiring the adjacent line to be clear), it was conveyed as a special train, and staged so that movement was mainly at weekends. The route taken was *via* York, Swindon, and Banbury.

The car was manufactured by Head Wrightson, Teesdale Limited to the design of the Treadwell Company of America, under licence to the International Construction Company. With a capacity of 180 tons, it is by far the largest hot-metal mixer-type car in the country, and will be used to transfer molten metal from blast furnaces to steel plant.

Tipping of the ladle is achieved by means of a built-in remotely-controlled electric motor, working through a reduction gearbox, which enables the rate of pouring to be accurately controlled. There is also provision for tipping of the ladle by a hand-operated rotating mechanism.

The overall dimensions of the car are 10 ft. 7 in. wide, 55 ft. 6 in. long, and 13 ft. 4½ in. high.

Hot-metal car forwarded from Thornaby by North Eastern Region of British Railways

CONTRACTS & TENDERS

South African Railways has awarded a contract for 100 buses for their highway services to the British concern, Associated Commercial Vehicles Limited. The order is worth £500,000 and was secured in the face of competition from Italy, France, the U.S.A. and Germany. The buses are 175 h.p. diesel-engine single-deck.

Leylands has also been awarded a chassis contract by the Railways, who are at present spending about £700,000 on modernising their road transport services.

British Railways, London Midland Region, has placed the following contracts:

Regal Stone Cleaning & Restoration Co. Ltd.: cleaning of stonework at Carlisle Citadel Station;

The Limmer & Trinidad Lake Asphalt Co. Ltd.: resurfacing of platforms at Preston Passenger Station;

John Booth & Sons (Bolton) Ltd.: supply, fabrication and delivery of steel work for reconstruction of Bridge No. 6 superstructure at Leek Wooton on the Coventry-Leamington line;

Francis Brown (Decorators) Limited: cleaning and painting of Bolton Trinity Street Passenger Station.

The following orders have been placed with the General Railway Signal Company:—

The Central Railway of Brazil: Installation of 43 miles of centralised traffic control on two heavy-traffic suburban lines near Rio de Janeiro, Brazil. A "Traffic Master" control centre will enable two operators to control the entire territory over a 14-mile code line to Deodoro. "Quiktrol" high-speed coding system will be used to control 130 switch machines and 231 signals between Deodoro and Matadouro, and between Deodoro and Japeri.

The Taiwan Railway Administration:

Installation of 54 miles of Type K2 centralised traffic control between Chunan and Changhua. Two transistor carrier links operating from the sectional-type control machine in Changhua will permit efficient handling of the heavy traffic on this single-track line.

The Netherlands Railway:

Installation of 27 miles of centralised traffic control on the suburban line between Utrecht and Amersfoort. "Quiktrol" high-speed coding system will enable the railway to handle up to 363 trains per day, including 35 freight trains.

The National Railways of Mexico:

Centralised control of traffic between Irapuato and LaGreiga, Mexico. A "Traffic Master" control centre will be located at Queretaro.

The New Zealand Government Railways is calling for quotations for the supply of 20 points mechanisms which are required to be supplied complete with drive unit, rods and pins, suitable for mounting on either left- or right-hand side of track. Copies of the specifications and drawings are available from the High Commissioner for New Zealand, 415 Strand, London, W.C.2. The reference No. is C/G 99/3344—R.S.7807. Tenders will close at the Comptroller of Stores' Office, Wellington, New Zealand, on December 6, 1961. Details may also be obtained from New Zealand representatives in Washington, Tokyo, and Sydney.

The Export Services Branch, Board of Trade, has received calls for tenders as follow:—

From Portuguese East Africa:

Submission of project and construction of the foundations of the loading platform of the general workshops of Beira Railways based on an authorised expenditure of Esc: 1.850,000 $00.

The issuing authority is the Ports, Railways & Transport Department, Lourenco Marques, to which bids should be sent. The tender No. is 13/VO/CFB/61.

The closing date is December 27, 1961. The Board of Trade reference is E.S.B./31918/61.

Further details relating to the above tenders together with photo-copies of tender documents, unless otherwise stated, can be obtained from the Branch (Lacon House, Theobald's Road, W.C.1).

NOTES AND NEWS

Sir Reginald Wilson (centre), and Mr. J. Royston, Line Traffic Manager, Crewe (right), at Stafford Station (see reference below)

British Transport advertising. In an editorial note in our issue last week we stated that £251,000 was spent in or during the 12 months ended June 30, 1961 by British Transport Advertising. This should have read £251,000 more was spent than in or during the 12 months ended June 30, 1960.

Closing of station. Southerndown Road Station (Glam.), between Bridgend and Barry, on the Western Region of British Railways is to close on October 23.

B.T.H.A. annual general meeting. The annual general meeting of the British Travel & Holidays Association was held on October 11 at Grosvenor House, London.

Mullard change of telephone number. The telephone number of Mullard Equipment Limited, Crawley New Town, Sussex, will be Crawley 28787 from October 23. (Until that date: Crawley 3421.)

Efficiency in the office. A one-day conference of the British Institute of Management on "Efficiency in the Office" will be held at the Connaught Rooms, London, W.C.2, on November 23, from 9.45 a.m. to 5 p.m. Mr. R. D. Young, Assistant Managing Director, Tube Investments, Limited, will take the chair.

Running and maintenance conference. The Great Eastern Line of the Eastern Region of British Railways recently held the first of a series of running and maintenance conferences at Ilford training school. Mr. W. G. Thorpe, Line Traffic Manager (Great Eastern) opened the conference, and, he and Mr. T. C. B. Miller, Chief Mechanical & Electrical Engineer, were the main speakers.

London Midland Area Board visit. The London Midland Area Board of the British Transport Commission visited the West Midlands Division of the Region on October 4 and 5. The itinerary included visits to Coventry passenger station, Walsall freight terminal, and Stafford passenger station, all under construction. The illustration shows Sir Reginald Wilson (centre), Chairman, London Midland Area Board, Mr. J. Royston (right), Line Traffic Manager, Crewe, and Mr. G. H. Atkinson (left), Stationmaster, Stafford, during the visit to Stafford.

Inland waterways conference. Britain sent two delegates, Mr. W. L. Ives, and Mr. V. H. Tripp, Members of the British Waterways Board of Management, to a three-day international inland waterways conference in Paris.

Passenger ferry withdrawal. British Railways, Eastern Region, has announced that after December 30, the ferry service between Harwich, Felixstowe and Shotley will be withdrawn.

Glasgow electric service. During the first week of resumed operations of the Glasgow electric trains (October 2-8 inclusive) and despite the fact that only five days' notice was given—against more than five weeks last year—of the trains' availability, almost 400,000 journeys were made. Only 6 per cent less than the 1960 average. Record punctuality was achieved. Of the 2,084 trains run during the first week, 1,941—or 93 per cent—arrived on time. Highest and lowest punctuality percentages were 96 and 89 respectively.

The 1,000th Rigidhobber. Churchill Gear Machines Limited has recently delivered to Gresham & Craven Limited the 1,000th Rigidhobber made. The illustration shows Mr. H. A. G. Livock, General Manager, Gresham & Craven Limited, receiving the machine from Mr. J. B. S. Gabriel, Chairman of the Churchill group. In the background, from left to right, are Mr. G. S. Cutts, General Sales Manager, Churchill group, Mr. J. Mills, Director & General Manager, Churchill Gear Machines Limited, and Mr. R. Gabriel, Managing Director, Churchill group.

Mr. H. A. G. Livock receiving the 1,000th Rigidhobber from Mr. J. B. S. Gabriel

Helping the passenger. British Railways, North Eastern Region, is to hold a series of discussion meetings between railway staff who meet the public and Stationmasters and Inspectors to find out the best way of providing good personal service for passengers.

Parcels services. On October 9, British Road Services (Parcels) Limited extended its parcels and smalls service operating from the York depot. It provides collection and delivery services to several places previously covered by Leeds and Hull parcels depots and is to introduce services over a wider territory.

Closing of station. Burnley (Manchester Road) Station is to be closed to passengers and parcels traffic by the London Midland Region of British Railways from November 6 this year.

New livery for C.I.E. trains. The C.I.E. has devised a new livery for its passenger trains. The new colours are golden brown up to window level, black for the next four feet, and a 6-in. white band right around, with the roof, ends, and underframe in black.

Course in applied pneumatics. A course in applied pneumatics was held at Farnham, Surrey, from October 2 to 6. Sponsored by Martonair Limited, Parkshot, Richmond, Surrey, the course comprised lectures on compressed air theory; circuit design; mechanism and machine design; equipment design; maintenance; hydro-pneumatics, and other topics. A works visit and practical sessions were included. Further courses are being held on October 30 and March 5 and 26, 1962. Vacancies exist on a course commencing on April 16, 1962.

L.A.M.A. Exhibit at Pacific International Trade Fair, Lima. When the Pacific International Trade Fair at Lima, Peru, opened on October 12, 1961, visitors to the exhibition saw two impressive photographic displays. The exhibit has been arranged by the Locomotive & Allied Manufacturers' Association of Great Britain in co-operation with the Board of Trade. One of the displays features the progress of modernisation on British Railways, whilst the other highlights the contribution of the British Locomotive and rail traction equipment Industry to Latin American railways generally.

The Euston Players, L.M.R. (London) Dramatic Society. On October 12, 13 and 14, the Euston Players presented at the French Institute, Kensington, "The More the Merrier," a comedy by Ronald Millar. The cast included many well-known names all of whom acquitted themselves well. The play was amusing and centred round the divorced parents, played by Joyce Cordery as Stella Felby, the wife; Jack Pegg as Roger Felby, the husband; of Dinah Felby, their daughter, most amusingly played by Miriam Ahern, who is a talented young actress. There were good supporting performances by Peggy Kirby as Anne Allen, a press photographer; John Ahern as Leonard Lee, a reporter; Jane Loring, as Stella Felby's sister, played by Frances Davidson; Nanny, by Hilda Pendrell; and Mr. Gosport, a solicitor, by Richard King. The play was produced by Jack Pegg. We understand that this comedy has only recently been released for amateur production and the Euston Players is one of the first societies to produce it under these conditions.

Railway Stock Market

Little business was passing in foreign rails. There was a small amount of selling of Antofagasta ordinary stock, which eased from 17½ to 16½ following Mr. Harold Drayton's cautious annual statement. The preference stock at 35 was within half-a-point of the level a week ago. Chilean Northern 5 per cent first debentures were 48½, while Brazil Railway bonds kept at 3¼, and Paraguay Central prior debentures at 18. Mexican Central "A" bearer debentures lost a point at 57. International of Central America common shares kept at $15½ and the preferred stock at $90. San Paulo Railway 3s. units were again quoted at 1s. 11¼d.

Canadian Pacifics, helped by the trend of Wall Street, were quite well maintained at $44; the 4 per cent preference stock was maintained at 54, but the 4 per cent debentures moved fractionally lower at 53¾. White Pass shares strengthened to $11¾.

Nyasaland Railways shares eased from 11s. 3d. to 11s. The 3½ per cent debentures were 40. West of India Portuguese capital stock was marked up to 136, and Barsi Light Railway was again quoted at 17. Midland of Western Australia unified stock was 11.

Shares of locomotive building, engineering, and kindred companies were lower with the general trend of markets, though in many cases movements have not been more than a few pence. Beyer Peacock 5s. shares remained at 6s. 3d., Charles Roberts 5s. shares eased from 5s. 7½d. to 5s. 3d., but Wagon Repairs 5s. shares remained a steady feature at 25s. 3d. Gloucester Wagons 10s. shares fell from 8s. to 7s., but attracted buyers at the lower level. G. D. Peters were steady at 17s., though elsewhere, Birmingham Wagon dropped back from 30s. to 27s.

Westinghouse Brake were marked down sharply from 29s. 3d. a week ago to 25s. 6d. on the surprise news that British Transport has requested the company to cease production of brake cylinders being made under a long-term contract. Reflecting the unexpected decision not to pay an interim dividend, Babcock & Wilcox shares have fallen to 20s. which compares with 23s. 9d. a week ago. Guest Keen dropped from 88s. to 79s. 6d., and there were sharp declines in steel shares, notably Steel of Wales which were affected by the labour troubles. Elsewhere, Ruston & Hornsby lost 1s. 3d. at 21s. 6d. Vickers were lower again at 27s. and, in other directions, Leyland Motors reflected the general trend and at 78s. compared with 83s. 3d. a week ago. T. W. Ward, however, at 68s. have held up quite well, helped by the good impression created by the results. Broom & Wade 5s. shares declined to 25s. 6d., and British Oxygen 5s. shares from 17s. 3d. to 15s. 6d. Pressed Steel 5s. shares dropped from 18s. to 16s. Among electricals, A.E.I. lost 1s. 3d. at 29s., G.E.C. were 24s. 3d. compared with 25s. 9d. a week ago, and English Electric 26s. 3d., a decline of 1s. on balance.

Forthcoming Meetings

Oct. 21 (*Sat.*). Institution of Railway Signal Engineers (Bristol). Visit to Newport signalling installation.

Oct. 23 (*Mon.*). Permanent Way Institution. "Reconstruction works at Farringdon," by Mr. E. F. Glover, L.T.E. 6.30 p.m. 222 Marylebone Road, N.W.1.

Oct. 24 (*Tue.*). Institution of Locomotive Engineers. "Control of diesel-electric locomotives," by Mr. O. Schlaepfer. 5.30 p.m. 1, Birdcage Walk, S.W.1.

Oct. 25 (*Wed.*). Institution of Locomotive Engineers. Visit to Bristol Siddeley Engines Limited, Ansty.

Oct. 25 (*Wed.*). Peterborough Railway Discussion Group. Research & Development (Carriage & Wagon), by Mr. C. F. Rose, B.T.C. 6.45 p.m., Eastfield Road.

Nov. 1 (*Wed.*). Electric Railway Society, at the Fred Tallant Hall, 153, Drummond Street, N.W.1, at 7 p.m. "Rolling stock of the Central London and London & North Western Railways." Mr. B. J. Prigmore and Mr. F. G. B. Atkinson.

Nov. 7 (*Tue.*). Institute of Transport, annual anniversary luncheon at the Connaught Rooms, Great Queen Street, London, W.C.2, at 1 p.m.

Nov. 7 (*Tue.*). Institute of Traffic Administration London Centre, at Caxton Hall, London, S.W.1, at 6.30 p.m. "Traffic engineering in practice," by Mr. Ernest Davies.

Nov. 7 (*Tue.*). Institute of Traffic Administration, Southampton Centre, at Royal Hotel, Southampton, at 7.30 p.m. "The work of the railway traffic superintendent," by Mr. A. C. J. Payne.

Feb. 23, 1962 (*Fri.*). Royal Engineers Army Emergency Reserve (Transportation). Annual Dinner. Cafe Royal, Regent Street.

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2. Tender Papers containing Instructions to Tenderers, Conditions of Contract and Specifications may be purchased from the office of the General Manager & Chief Engineer, Railway Electrification, 235, Acharyya Jagadish Bose Road, Calcutta-20, on and from 10th October, 1961, on payment of Rs.25/- (£1 17s. 6d.) per copy which shall be deposited in cash with Cashier, Railway Electrification, 232, Acharyya Jagadish Bose Road, Calcutta, 20 or sent by money order to the above named official.

3. Tenders shall be submitted in seven copies in accordance with the instructions given in the Tender Papers, six copies of the Tender shall be submitted to the office of the General Manager & Chief Engineer, Railway Electrification, at or before 3 p.m. I.S.T. on the 30th December, 1961. The seventh copy of the Tender shall be submitted to the Société Nationale des Chemins de fer Francais (D.E.T.E.), 41, Boulevard De La Gare, Paris XIII, on or before 10.30 a.m. Paris time on the same day.

4. The earnest money to be deposited for each tender is Rs.12,000. A security deposit of Rs.60,000 will have to be made by the successful tenderer on placing the order. All relevant particulars are available in the Tender Papers, but any clarification required will be given by the General Manager and Chief Engineer, Railway Electrification.

5. Tenders will be opened at 3.30 p.m. on the 30th December, 1961, in the presence of Tenderers, if any, at the office of the General Manager and Chief Engineer, Railway Electrification, Calcutta. Tenders submitted to S.N.C.F. (Paris) will be opened at 11.00 a.m. Paris time on the same day.

6. On no account will the last date of tendering be extended.

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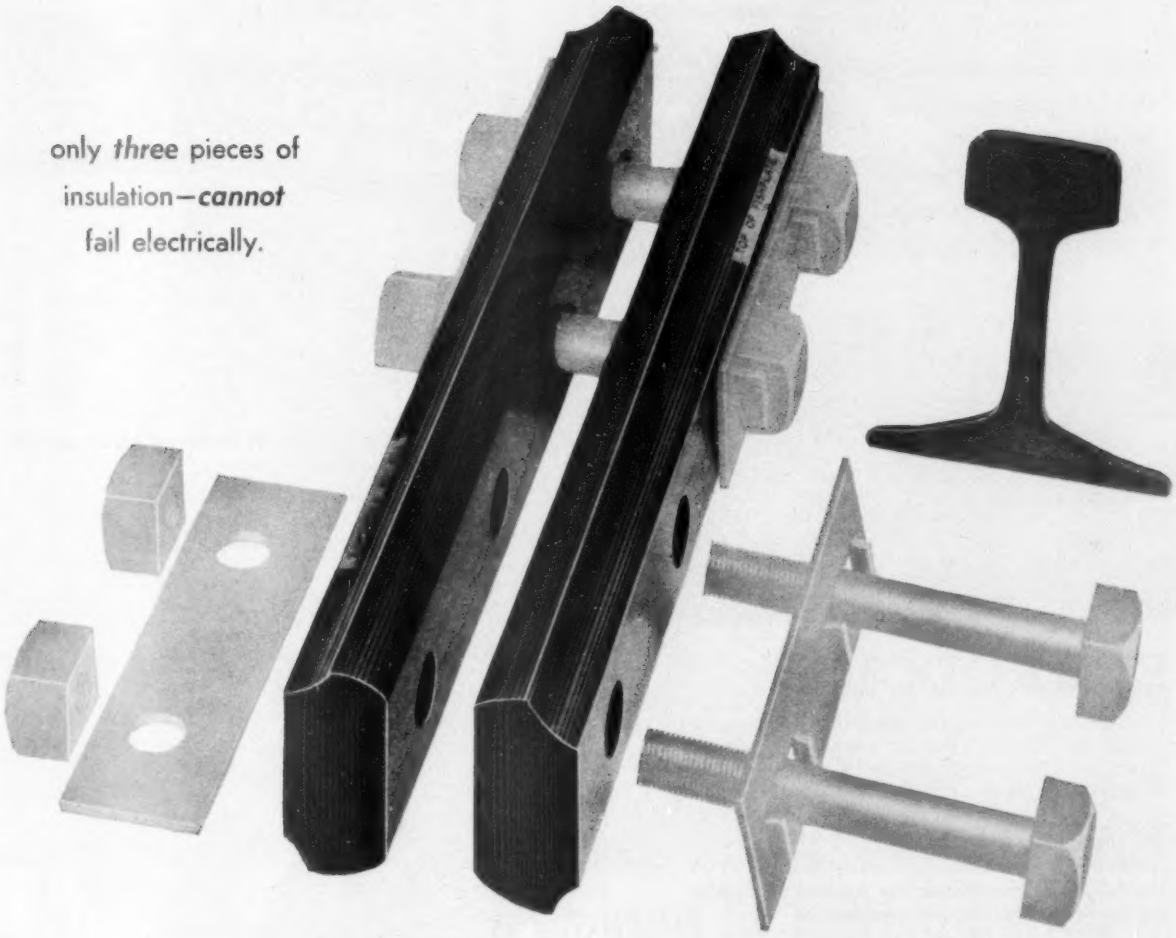

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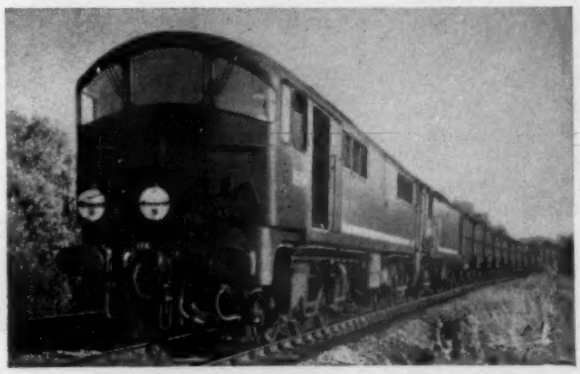

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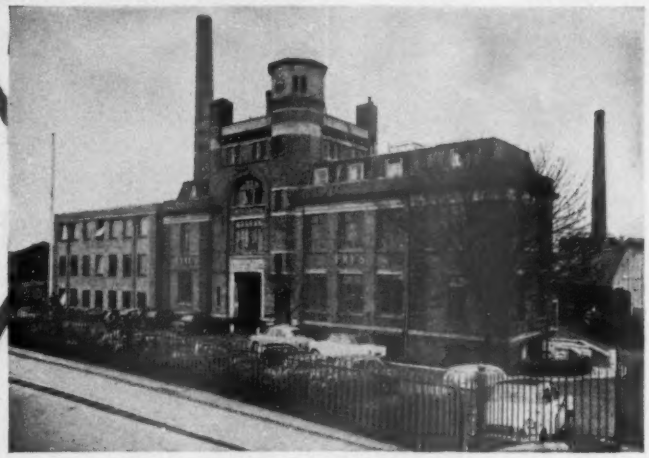

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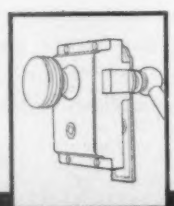

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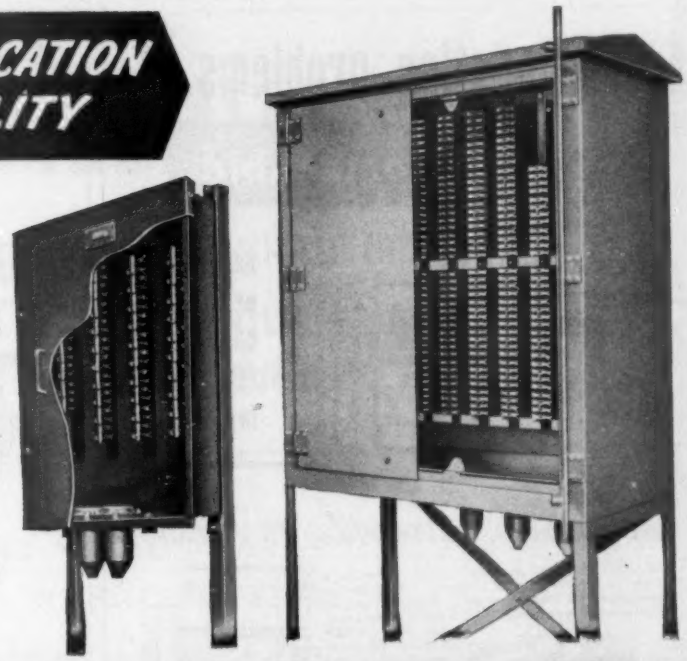

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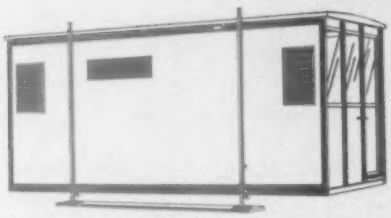

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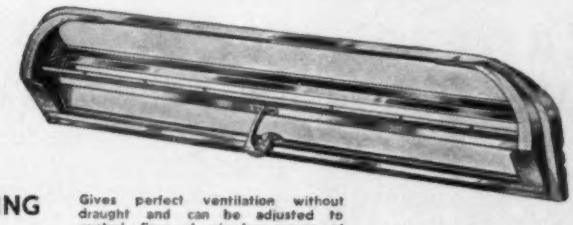

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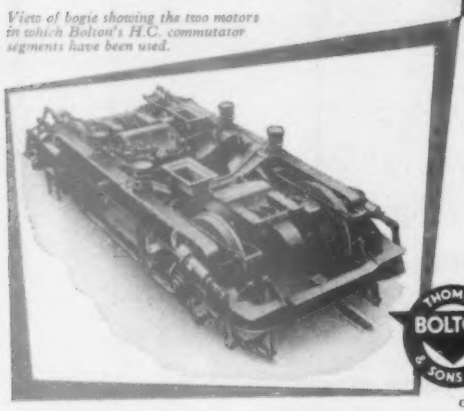

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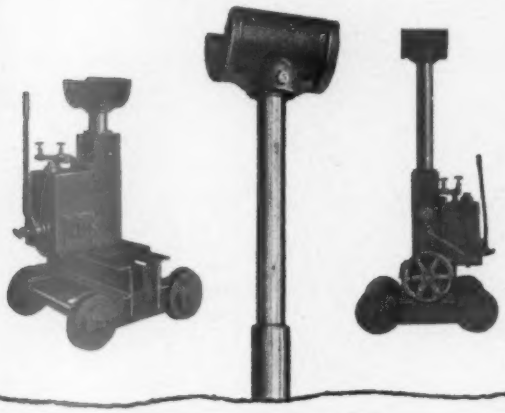

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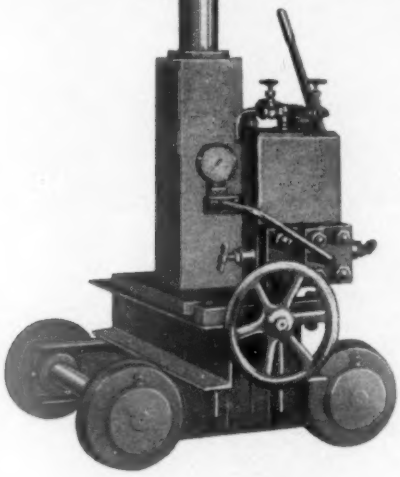

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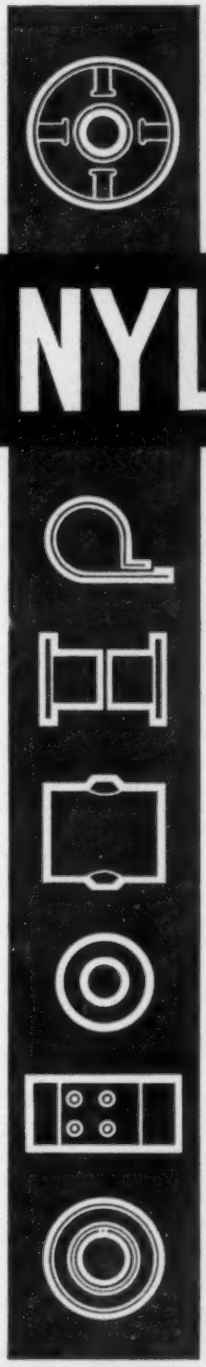

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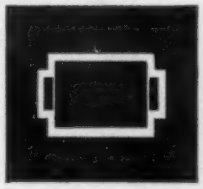

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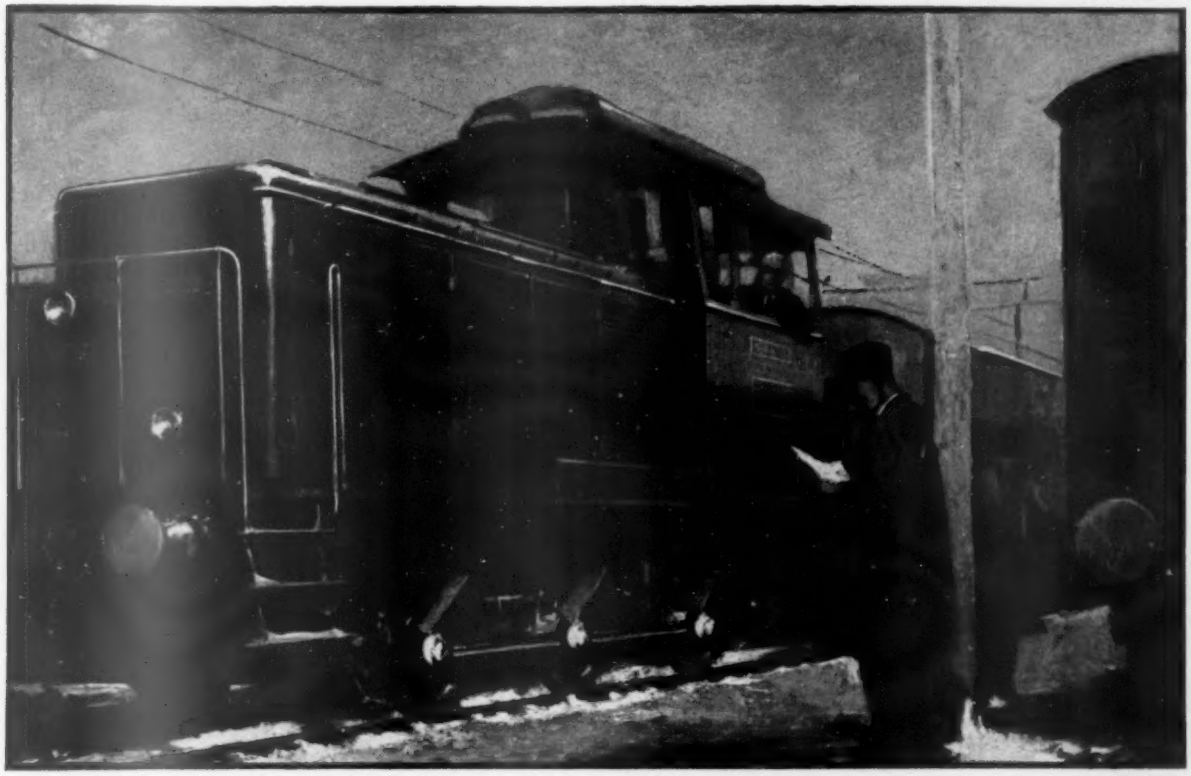

Swiss Diesel-Electric Shunting Locomotives

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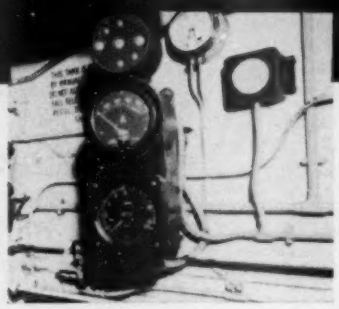

AEI-GRS Equipment at Margam, British Railways, Western Region. (*Left*) Hump signal and crest of hump. (*Centre*) Interior of shunting locomotive cab showing hump repeater signal. (*Right*) Receiving coils mounted under shunting locomotive. (Photographs by courtesy of British Railways)

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